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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

RADIOGRAPHY IN THE DIAGNOSIS OF DISEASES OF THE ACCESSORY NASAL SINUSES.

PART II.

THE LATERAL, VERTICAL AND OBLIQUE VIEWS. ANATOMICAL CONSIDERATIONS AND TECHNIQUE.

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NOTE.—In the first article of this series, which appeared in the number for May 1915, two of the illustrations were accidentally transposed. The one numbered figure 3 should be figure 8, and *vice versa*. Figures 3a and 8a, however, are correctly numbered.

The first article of this series, published in the ARCHIVES May, 1915, dealt principally with the technique advisable for radiography of the skull through

the postero-anterior plane, and also touched briefly on some of the information to be derived from a study of this view.

In order to obtain the fullest possible information regarding the size, condition and relations of the sinuses, it is necessary to take additional plates with the rays passing through other planes. The methods of obtaining these views will therefore be stated, and the various landmarks shown in the illustrations indicated.

Following this, a study of the individual sinuses will be made and their variations noted, in order to ascertain how much anatomical information with regard to them and their relations may be obtained by radiography.

Since, for the present, only anatomical information is being sought the illustrations are again taken from dried skulls, for the reasons already explained in the preceding article, and they are numbered in continuation of that series. The next section will deal with the pathological aspect and will illustrate the sinuses as seen in living heads, both in a state of health and when the seat of inflammatory or other changes.

Of the additional views required by far the most important is the lateral, in fact, in the majority of cases, the information desired may be obtained from two plates only—a postero-anterior and a lateral view—the other positions merely being required to elucidate special points not sufficiently made clear in the usual views.

Technique for Lateral Views.—The patient may either sit upright or lie on the side ; in the latter position it is easier to immobilise both plate and patient, and, in most cases, this position is free from the objections to the prone one, as stated in the preceding article. When the patient is seated, the plate can be held in a clip and kept in apposition to the side of the head.

Whichever position be adopted the central ray should traverse the head in a strictly tranverse plane, and the plate should be at right angles to the central ray, being thus parallel with the sagittal plane of the head. The best point on which to centre the tube is one inch above and one inch in front of the external auditory meatus. This position gives the best view of the sphenoidal sinuses and affords a good general view also : other points may be selected for centring if any special area is required to be examined. All the illustrations of lateral views in this article have been taken with the tube centred on the standard spot. If a lateral stereoscopic pair is desired this point is taken as a centre and the tube displaced 3 centimetres anteriorly and posteriorly for the two plates.

The various landmarks seen in a normal lateral view are as follows, and are shown in figures 11 and 12. Figure 12 is a lateral view of half of the the same skull shown in full lateral view in figure 11, and is introduced in order to demonstrate the effect of superimposing the shadows of the two sides and to facilitate their correct interpretation.

In front is seen the frontal sinus in profile, and running downwards and backwards from it are several dark bands of shadow. These shadows are cast by the varying levels of the floor of the anterior cranial fossa : the number of separate

lines depends on the contour of the bone in this region, and especially on the presence or absence of orbital extensions of the frontal sinuses.

A comparison of figure 11, which is a lateral view of the whole skull, with figure 12, which is the corresponding view of half of the same skull, will show that the majority of these lines of shadow are cast by that half of the skull which is nearer to the plate. In viewing a stereoscopic pair the contour of the whole of the floor of the anterior cranial fossa can be seen, but again the half nearer to the plate is much more distinct than the other. The bone in this region is so thin that it only casts a distinct shadow when comparatively near to the plate.

At the posterior end of this combined band of shadow the anterior clinoid processes may be distinguished; they in turn are followed, still travelling backwards, by the sweep of the sella turcica ending behind in the prominent posterior clinoid processes. In front of the sella turcica is seen the outline of the sphenoidal sinus, in this case quite thin-walled. In figure 12 only one sinus is seen, whilst in figure 11 the two are superimposed.

Below the sella turcica is the body of the sphenoid, and behind this is the dense mass of shadow cast by the petrous portion of the temporal bone, with the external auditory meatus just distinguishable as a light spot near its centre: the meatus is much more clearly seen in figure 15, and, if its position be noted, it will be seen that the spot one inch above and one inch in front of it, on which it was advised that the tube should be centred, is approximately in a direct tranverse line passing through the posterior clinoid processes.

Above and behind the petrous shadow are seen the clear areas of the mastoid cells, whilst below is the mastoid process itself. The cellular nature of the mastoid region is particularly well seen in figure 12, where it is not clouded by the shadow of the opposite side of the skull being projected on to it, but the cells can still be seen plainly in figure 11.

Returning to the front portion of the skull, the dense shadow of the malar bone is a prominent feature; its details can be best seen in figure 12, where only one is present. This bone is so dense that the plate depicts a good shadow of the malar on the opposite side of the head, thus causing some confusion of outline. At the upper end of the malar shadow the articulation between the external angular process of the frontal bone and the frontal process of the malar is easily distinguished: from this point the malar bone sweeps downwards and forwards in a broad curve, whose anterior edge is the external margin of the orbit. At the lower end of the curve is the body of the malar bone, and running forwards from it, foreshortened in this view, is the maxillary process. Running backwards from the body of the malar is the zygomatic process, which articulates with that of the temporal bone and forms a band of shadow of much less density than that of the remainder of the malar.

Behind the upper portion of the malar shadow may be discerned the clear areas of the ethmoidal air cells, extending from the region of the frontal sinus anteriorly to that of the sphenoidal sinus behind. In figure 11 the view of this area is somewhat obstructed by the projection on to it of the shadow of

the opposite malar bone: this can be thrown further forwards when desired by centring the tube further back.

Below the ethmoid region the large clear area of the maxillary antrum is easily visible, though its front portion is obscured by the malar bone, and the shadow of the zygoma lies across its back portion. The floor of the cavity, formed by the palatine part of the maxilla, is distinctly marked, and the projection of the outer portion of the antrum to a lower level, in the form of an alveolar recess, is well seen in both illustrations.

Technique of the Oblique View.—As previously stated, oblique views are not often required in examination of the sinuses, but are occasionally useful in order to clear up doubtful points in diagnosis. There are various directions in which oblique views of the head can be taken, and each has its special uses; but only one of them, the postero-anterior oblique, is required in investigating the sinuses. The technique of this view consists of arranging the patient and apparatus as for a direct postero-anterior view, and then displacing the tube laterally, through a measured distance, parallel with the plate. By proceeding in this manner the view can be exactly duplicated at any future time if required. A useful lateral displacement of the tube is two inches, and the result obtained from such a position is shown in figure 13. It will be noticed in this illustration that the sphenoidal sinus is now projected on to one side of the nose and on to a portion of the orbit, whilst the shadow of the petrous temporal is thrown practically clear of the antrum on one side, thus allowing of greater detail examination of that cavity. The ethmoid area of one side (the right hand side of the illustration) is also brought into fuller view.

Though this oblique view does not allow of comparison being made between the two sides of the head, yet another plate may be taken with the tube displaced to an equal extent on the other side of the median line, and thus an exact comparison can be made. To a certain extent this resembles the technique of taking a stereoscopic pair, but the movement of the tube is through a greater distance in the case of the oblique view. Parenthetically it may be stated, though germane to the present subject, that this oblique view is particularly useful in examination of the malar bone for suspected disease or injury.

Technique of the Vertical View.—The technique and landmarks of the postero-anterior and lateral views have been somewhat fully described as these positions can be exactly imitated in the living subject, and a well made radiograph of a head will exhibit the points above demonstrated on the skull. There still remains one principal plane, the vertical, in which the skull may be radiographed, but here the resemblance between plates of living heads and dried skulls is only very slight. It is a perfectly easy matter to lay a skull upon a plate and make an exposure with the rays passing vertically downwards through it, but this, of course, is not possible in the living subject. In the latter case the nearest approach to a vertical view which can be obtained is either by using Pfeiffer's position, in which the patient sits on a low stool by the side of the table and thrusts his chin forwards over the plate, or by placing a plate inside the mouth. The disadvantage of the latter view is that only a

small plate can be used, whilst that of the former position is the distance which separates the plate from the base of the skull. Fortunately, this view is not very often required, since an adequate diagnosis of the condition of the maxillary, ethmoidal, and frontal sinuses can be made from the views already discussed. There still remain the sphenoidal sinuses, and it is in order to depict them side by side that the vertical view is required.

Though the resemblance between the plates obtained during life and those taken of the macerated skull is slight, it is still advisable to make a preliminary study of the latter condition to facilitate diagnosis in the former ; a vertical view of the skull is therefore shown in figure 14, with the main landmarks titled in the corresponding outline drawing. Since the conditions are so vastly different to those obtaining during life, it would be waste of time to enter into details regarding the various shadows, and the illustrations are therefore left to speak for themselves. The sphenoidal sinus on one side has been rendered opaque by means of bismuth paste, and the other has been left clear for comparison. The tube in this case was centred on the vertex of the head in the middle line, at a point one inch in front of a line joining the external auditory meatus of one side to that of the other. A lateral view of the same skull is shown in figure 15.

At this juncture it may be useful to remark that, in all cases, much more information can be obtained from stereoscopic pairs than from single plates. Not only do many puzzling shadows clear up and show their true origin when seen in relief, but the combination of two different view-points, whilst the head is in the same position, allows areas to be reached which cannot be fully demonstrated in a single plate.

Having now discussed the technique and landmarks of the various views, it remains to correlate them in order to ascertain how much anatomical information can be elicited from them, to study the variations which occur in the size and relations of the sinuses, and to note the influence which these variations may exercise upon prognosis and treatment in cases of pathological affections of the sinuses. For this purpose the sinuses will be taken singly.

The Frontal Sinuses.—By combining the information obtained from the postero-anterior and lateral views, we may discover the extent of the sinuses laterally and vertically, and their antero-posterior depth, also the degree, if any, to which they invade the orbital plate of the frontal bone. The thickness of each of their walls will be manifest, and much useful guidance may be given to the surgeon as to their accessibility or otherwise by the nasal route. When attempts are made to catheterise the sinus, radiography will show whether the attempt is successful ; indeed, this was one of its earliest applications in sinus disease. Examples of this will be shown in the next article, and considered along with the diagnosis of pathological changes.

The variations in the frontal sinuses are very extensive—more so than in the case of any of the others. These cavities are not present at birth, but are formed later as invaginations excavating the bones in which they are found in adult life, reaching their full development only at or after the period

of puberty. Cunningham says that they cannot be distinctly recognised before the age of 7, whilst Treves states that they are not marked until 10. Killian, however, records a case in which he actually opened the frontal sinus, and found it diseased, in a child of 1¼ years. The above will sufficiently demonstrate the importance of ascertaining the elementary fact as to the presence or absence of the sinus, especially in children.

The frontal sinuses develop as extensions of the anterior ethmoid cells, and their development may cease at any point, so that a true frontal sinus may be absent, and its place be taken by an enlarged ethmoid cell. Mosher (*Laryngoscope*, 1906), found that this condition obtained in 30 per cent. of dissecting-room bodies. A very small frontal sinus on one side is shown in figure 5, and absence of one of them in figure 13.

On the other hand, one or both of the sinuses may be very extensive. Loeb reported, at the Third International Congress at Berlin, a series of measurements he had taken: his figures showed variations in the antero-posterior diameter from 9 to 33 mm., in the vertical from 14 to 51 mm., and in the lateral from 7 to 42 mm.—their capacity ranging from 0·9 to 8·2 c.c.

Tilley (*Lancet*, 1896), defined a normal frontal sinus as extending to about the junction of the inner and middle thirds of the supraciliary ridge and rising vertically about 20 to 22 mm. above the nasion. Amongst 120 skulls he found 23 that had abnormal frontal sinuses, estimated by this standard.

In a series of skull radiographs which I made I measured the size of the frontal sinuses in 81 cases, with the following results, their height being estimated with relation to a line drawn through the highest portions of the brim of the orbit on both sides.

4 cases did not rise above this line at all on either side.
12 cases failed to rise above the line on one side only.
7 cases rose less than ¼ inch.
15 cases rose between ¼ and ½ inch.
17 cases rose between ½ and ¾ inch.
13 cases rose between ¾ and 1 inch.
9 cases rose between 1 and 1¼ inches.
4 cases rose between 1¼ and 1½ inches.

Transverse measurements were taken only in those cases which rose above the trans-orbital line on both sides, and were taken from the extreme limit of the sinus on one side to that on the other. The figures are :—

2 cases between 1 and 1¼ inches.
0 cases between 1¼ and 1½ inches.
7 cases between 1½ and 1¾ inches.
8 cases between 1¾ and 2 inches.
10 cases between 2 and 2¼ inches.
16 cases between 2¼ and 2½ inches.
1 case between 2½ and 2¾ inches.
7 cases between 2¾ and 3 inches.
2 cases between 3 and 3¼ inches.

4 cases between $3\frac{1}{4}$ and $3\frac{1}{2}$ inches.

4 cases between $3\frac{1}{2}$ and $3\frac{3}{4}$ inches.

It will be seen that the greatest numbers in the above table lie between 2 and $2\frac{1}{2}$ inches, which corresponds to Tilley's definition of the normal sinus.

Another point to be noted in the frontal sinuses is the presence or absence of septa, complete or incomplete, causing loculation of the cavity. The importance of this detail in its relation to thorough drainage of the sinus is evident, and the septa are by no means rare. An elaborate article on this subject was published by Hoeve (*Laryngoscope*, 1907), and another by Cryer (*Journal of the American Medical Association*, 1907): the latter author mentions cases with as many as five distinct frontal sinuses, each with a separate outlet.

Logan Turner, in a paper read by him at the section of Laryngology and Otology of the American Medical Association, in 1904, referred to these septa and recesses, and ascribed failures in operations to their non-recognition. Examples of this condition are seen in figures 3, 6, and 10, and in a very marked degree in figures 19 and 20, which are the largest frontal sinuses I have seen.

The position of the septum separating the sinuses of the two sides should be noted, since occasionally it is so greatly deviated to one side that one of the frontal sinuses could be opened from the opposite side of the nose. Such a condition is seen in figure 6.

The importance of an air cell in the crista galli as being a possible route for the transference of infection from the frontal or ethmoidal sinuses to the meninges, has already been commented on.

With regard to the antero-posterior depth of the sinuses: this point can be ascertained from the lateral view as seen in figures 11, 15, 16 and 17. That there is no necessary connection between prominence of the brow and large frontal sinuses is demonstrated by figure 16, where the brow is very prominent and the sinuses very small. Other cases occur in which, on the other hand, the sinuses are very large without undue external projection.

The ordinary depth of the sinus is only of importance if an operation for its obliteration is contemplated, and the question of post-operative disfigurement is under consideration, but an extension of the cavity into the roof of the orbit and the floor of the anterior cranial fossa, along the horizontal portion of the frontal bone, may be of great import. An extension of this character is depicted in figures 11 and 12, which are lateral views of the same skull, illustrated in postero-anterior aspect in figures 3 and 7. In examining figure 12, which is a radiograph of half the skull, the orbital extension is particularly well seen. The double outline gives the impression that both sinuses are portrayed, but this is not the case. The duplication of outline is caused by the varying heights of the cavity at its medial and lateral extremes, each portion casting its own shadow. If comparison be made with figure 11, which shows the complete skull, it will be seen that the other sinus extends only a short distance along the roof of the orbit. It is necessary to bear this

possibility in mind when making a diagnosis of orbital extensions, as sometimes considerable difficulty is experienced in allocating each line of shadow to its proper sinus. This is one of the conditions in which a stereoscopic pair is of great assistance.

Onodi (*Laryngoscope*, 1909) mentions a case in which the frontal sinus extended to the middle cranial fossa, between the superior orbital fissure and the temporal fossa. One of the points in which this backward extension of the sinus is important, is that it may bring the cavity into close relationship with the optic nerve, and set up optic neuritis by a direct spread of infection.

In figure 15 is shown a frontal sinus of normal dimensions, which is confined entirely to the vertical portion of the frontal bone, whilst figure 17 illustrates large sinuses which have risen very high up the forehead, and extended across to the external angular process of the frontal bone on each side, yet have scarcely invaded the orbital roof at all. The transverse extent of the sinuses was, of course, determined from a postero-anterior view, though some idea of its magnitude in that direction can be gathered from figure 17, by observing the distance to which the lateral portion of the sinus projects behind the medial, thus indicating that it has passed round the corner of the forehead and entered the temple.

The thickness of the boundaries of the frontal sinus is important in three particulars :—(*a*) A thin posterior wall favours the spread of infection from the sinus to the meninges ; (*b*) A thick anterior wall may cause great difficulty in operations, or may even lead to their abandonment under the impression that the sinus is absent, unless radiography has previously demonstrated its presence ; (*c*) A thin floor favours spread of infection from the sinus to the contents of the orbit.

In figure 16 is seen a frontal sinus which might have caused considerable trouble to a surgeon : though small, it still could have been the seat of inflammatory changes. The very narrow floor would absolutely prevent catheterisation of the cavity for diagnostic purposes, the exceedingly thick anterior wall would render transillumination useless, and might have led to abandonment of an operation, as noted above. At the same time the posterior wall of the sinus is comparatively thin, and thus infection of the meninges would be quite a likely complication to occur.

The Ethmoid Cells.—Various opinions have been expressed as to the time of development of the ethmoid cells. Quain says that they first appear in the sixth month as depressions of the mucous membrane, but that their bony walls do not develop till after birth. Kolliker says that they are well marked at birth, and St. Clair Thomson remarks, in his book on diseases of the nose and throat, that the ethmoid labyrinth is not usually apparent in infant skulls. Howell Evans (*Ophthalmoscope*, 1908) states that the development of the ethmoid cells does not commence till the fourth or fifth year, and is not complete till the age of twenty.

Onodi has made a very minute classification of the variations of the

ethmoid, but it is not included here, as it consists largely of points which cannot be demonstrated radiographically.

The chief directions in which the ethmoid varies are :—(*a*) The total area occupied by the cells and their individual size; included in this is the projection of an enlarged ethmoid cell into the floor of the frontal sinus; (*b*) The thickness of the bony walls separating the air spaces from the cavities of the cranium and orbit; (*c*) The relationship of the ethmoid cells to the other accessory sinuses.

With regard to *a*, and *c*, much useful information can be given by radiography. The thickness of the walls is usually so small, and the bone of which they are composed is so radio-transparent, that it is difficult to give definite information: the orbital wall in particular is of tissue-paper consistency. In the case of the cranial wall more details can be made out; this portion of the bone forms part of the floor of the anterior cranial fossa, and can be seen in lateral view, especially if stereoscopic.

The postero-anterior view is the one which gives the most information as to the state of the ethmoid, though a fair view of the cells can be obtained in the lateral aspect, and the oblique view is sometimes useful in order to bring the cells of one side into greater prominence, but the whole of the ethmoid area is so radio-transparent that pathological changes can usually be detected at a very early stage of the process.

The cells are well seen in most of the illustrations of postero-anterior views accompanying the last article; they may extend low down and enter into close relationship with the maxillary antrum, as shown in figure 10, or may be separated from that cavity by a considerable thickness of bone, as seen in figure 9; the variations of these relations naturally exercises an influence on the likelihood of infection of one of the sinuses spreading to the other, a knowledge of the extent of the relationship therefore assists both in prognosis and in deciding what line of treatment to carry out. In the same manner the relations between the ethmoid on one hand, and the frontal or sphenoidal sinuses on the other, may be either remote or intimate, this point being capable of radiographic demonstration. Sometimes the ethmoid cells invade the lesser wing of the sphenoid bone; an example of this condition is shown in figure 5.

In radiographs of macerated skulls, the contrast between the clear areas of the ethmoid cells and the density of surrounding parts is not so striking as it is in living heads, as will be seen later: in the latter case the bright spots corresponding to the air cells are amongst the first areas to attract attention, and pathological diagnosis is accordingly facilitated.

The Maxillary Antrum.—Of all the accessory sinuses the maxillary antrum is the one least affected by anatomical variations. It is present at birth, and has then, according to Turner, the following dimensions :—vertical 3 mm., transverse 7 mm.; it will thus be seen to be of the nature of a transverse slit, the adult shape only being attained coincident with the development of the permanent teeth.

Though the presence of the antrum and its relations are fairly constant, it

is subject to wide variations in size. Thus, Loeb found the antero-posterior measurement ranged from 17 to 42 mm., the vertical from 17 to 47 mm. and the lateral from 7 to 33 mm.—the cubic capacity varying from 4·5 to 24·8 c.cm.

The anatomical points regarding the antrum which are capable of radiographic demonstration are :—(*a*) Its size ; (*b*) Its relation to other sinuses, notably the ethmoid, as already referred to ; (*c*) Whether any tooth roots project through its floor ; (*d*) The presence or absence of an alveolar recess.

The variation in size to which the antrum is subject is easily seen by a comparison of its outlines in the illustrations, for example, compare figures 11 and 15. The projection of tooth roots into the floor of the sinus is important in its relation to a likely avenue of infection in cases of dental caries or pyorrhœa, whilst the presence of an alveolar recess must be considered with reference to the question of efficient drainage in pathological states. A well marked alveolar recess is seen in figures 3, 7, 11, and 12, which are various views of the same skull ; figure 10 also illustrates this extension in another skull. The normal level of the floor of the antrum is the same as, or slightly higher than, the floor of the nose, as shown in figures 4, 5, 6, 8, and 13.

In a series of cases I examined an alveolar recess was present on one side 11 times, on both sides in 23 cases, whilst the floor of the antrum was at its normal level in 39 cases; it will thus be seen to be a very common abnormality. Extensions of the cavity into the palate are also seen, but are not nearly so frequent.

The most useful view for examination of the antra is the postero-anterior one, where a good outline of them may be seen and a direct comparison between the two sides instituted. The method of projecting the shadow of the petrous temporal so as to clear the cavity has already been considered, and the oblique view, as shown in figure 13, is sometimes useful: the distance to which the sinus extends backwards can only be estimated from the lateral position, in which view the shadows of the two antra are superimposed and cannot be sorted out from each other, unless the view has been taken stereoscopically.

The Sphenoidal Sinus.—The sphenoidal sinuses are not present at birth, but are formed later by invaginations of the nasal mucosa and absorption of the soft cancellous tissue of the body of the sphenoid; the date of their appearance has been placed by various authors at different periods, varying from the third to the twentieth year. Quain says that the first evidence of the sinus is a recess in the mucous membrane of the nose, which appears at the end of the third month, and that by the third year the bone has completely enclosed the sinus with the exception of the ostium. Symington has found the sphenoidal sinus well developed in a child of 6.

Although the sphenoidal sinus does not vary to anything like the same extent as the frontal, yet the variations in its size and the thickness of its walls are of considerable importance in their bearing on the likelihood of orbital or intracranial complications. The chief dangers in suppuration within the sinus are extension of the disease to the brain or its meninges, thrombosis and

suppuration in the intra-cranial venous sinuses, and implication of the optic nerve. Especially in the last named connection are the variations of the sinus important, since by them the relationship between the nerve and the cavity is entirely altered, ranging from total abolition of all relations on one hand to a very intimate connection on the other, or even bringing the sinus of one side into relationship with the optic nerve of the opposite side, or with both nerves.

The details concerning the sphenoidal sinus which are capable of radiographic demonstration are its presence or absence, its size—especially in antero-posterior measurement, the thickness of its walls, and its relationship to the sella turcica and the optic chiasma. Taking first the measurement of the walls of the sinuses with reference to the thickness of bone separating the cavity from the contents of the cranium, Onodi (*Laryngoscope*, 1909) from a series of measurements found that the thickness of the upper bony wall of the sinus varied from 1 to 14 mm., that of the posterior wall from 1 to 20 mm. Amongst the illustrations included herewith there will be seen some variation in the thickness of the walls, but none of them exhibit the extreme limits of which they are capable.

The size of the sinuses is subject to wide variations. Loeb found that the antero-posterior measurement varied from 2 to 42 mm., the vertical from 4 to 36 mm., the transverse from 2 to 35 mm., whilst their capacity ranged from 0·6 to 11·8 c.c.

St. Clair Thomson notes that the cavity is seldom absent, though it may be quite small; even smaller than a posterior ethmoid cell invading the body of the sphenoid and lying above the sinus. On the other hand, it may extend far out into the greater wing of the sphenoid: such an extension is shown in figure 18.

The extent to which the sphenoidal sinus extends backwards under the sella turcica, is subject to great variation: in figures 11, 12, and 16 it lies entirely in front of the sella turcica, in figure 15 it extends under the greater portion of it and in figure 17 (which is the same skull as shown in vertical view in figure 18), the sinus of one side extends to a little behind the posterior limit of the sella, whilst that of the other side reaches considerably further backwards into the basi-sphenoid. In the series of skulls which I examined, the number of cases in which the sinus reached backwards as far as the base of the posterior clinoid processes was just equal to the number of cases in which it failed to reach that area.

In one of Cryer's cases (*Journal of the American Medical Association*, 1907), the sphenoidal sinuses extended forwards and laterally both over and under the optic nerve, being only separated from it by a very thin bony partition, and also extended backwards and downwards into the basilar portion of the occipital bone.

In investigating the relationship between the optic chiasma and the sphenoidal sinus in a series of skulls, Loeb (*Journal of Laryngology, Rhinology, and Otology*, 1909) drew the following conclusions:—The optic chiasma is usually in relation to one or both of the sphenoidal sinuses; in one third of the

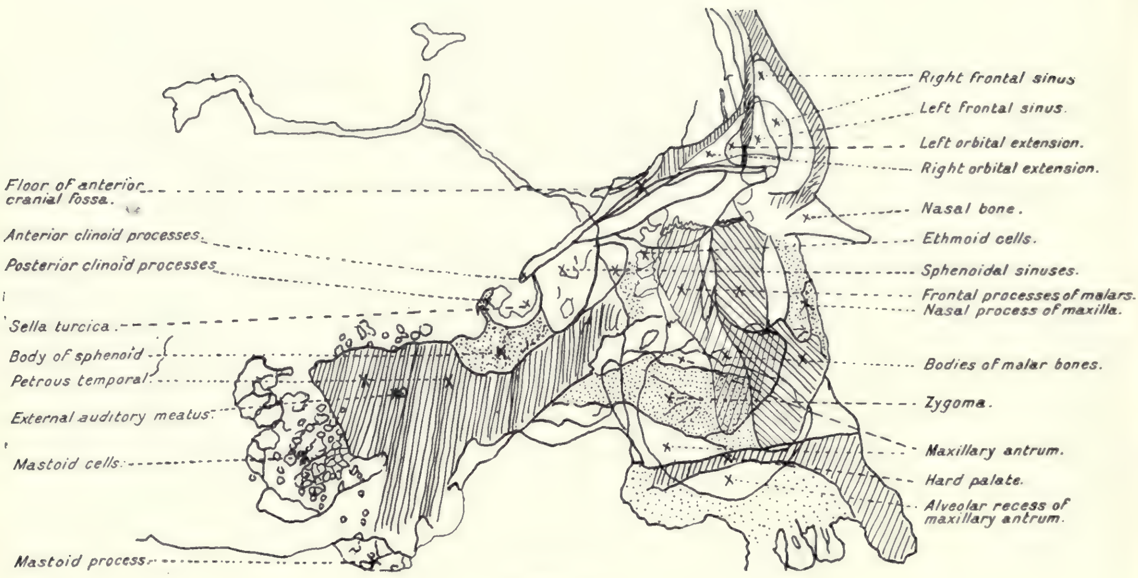

FIG. 11A.

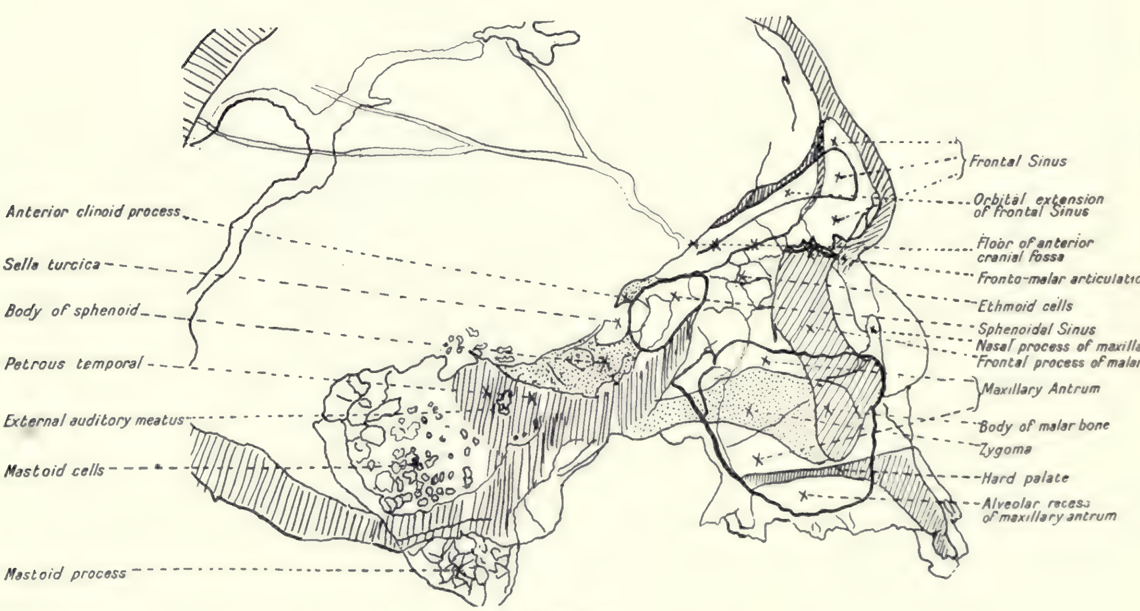

FIG. 12A.

PLATE 1.

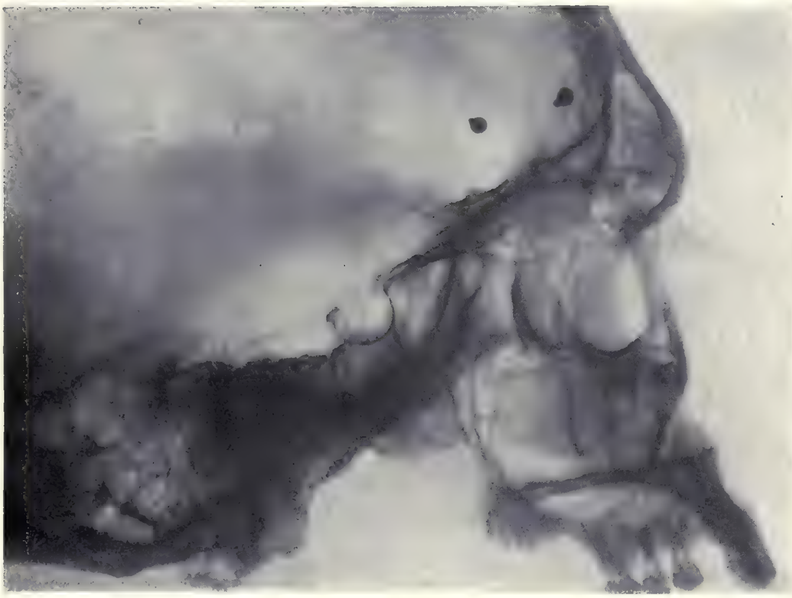

FIG. 11.

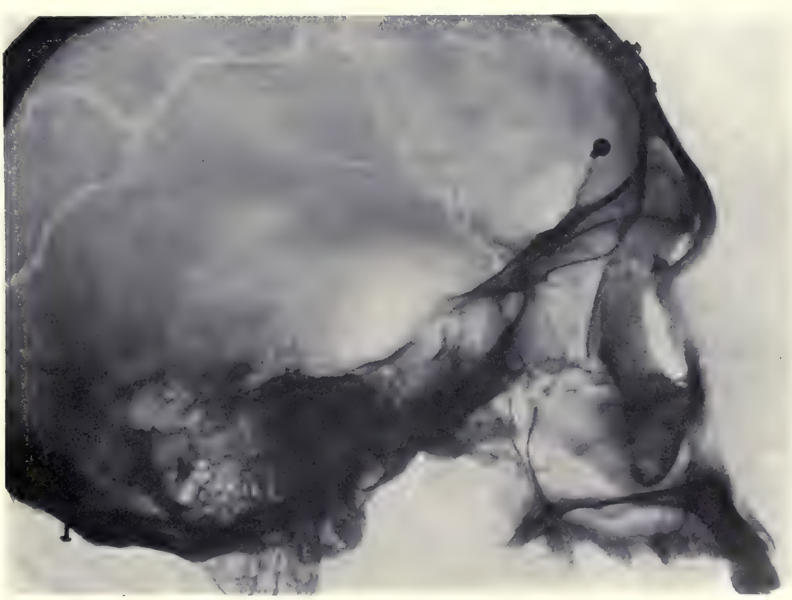

FIG. 12.

PLATE 2.

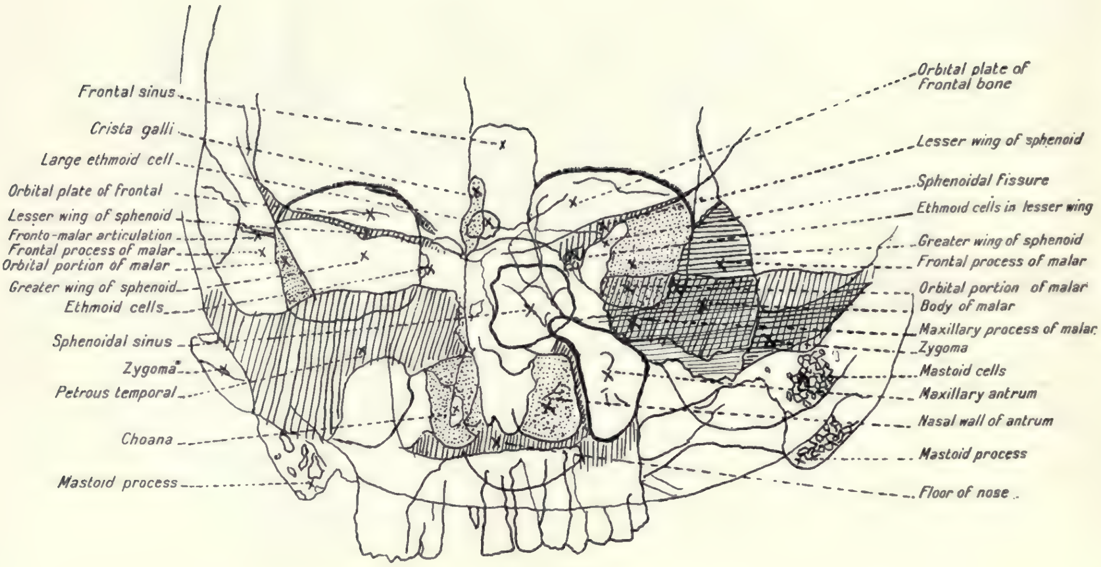

FIG. 13A.

PLATE 3.

Fig. 13.

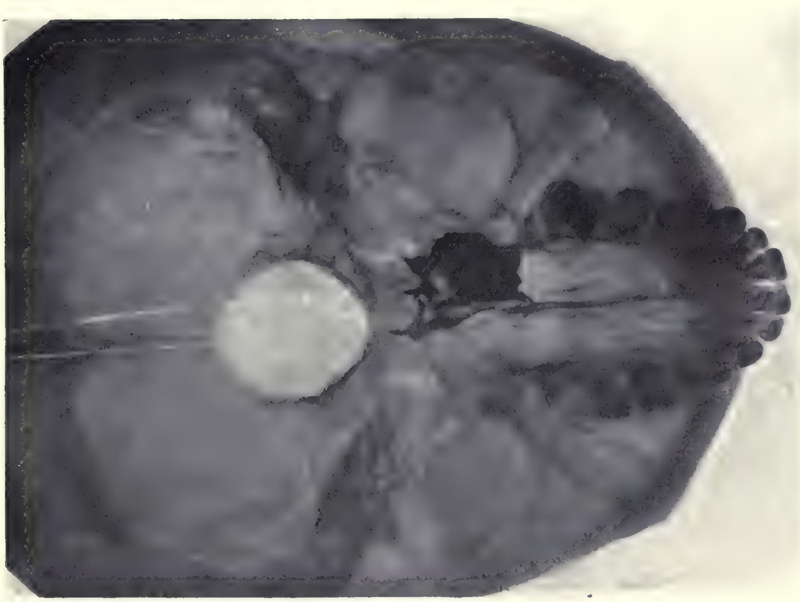

Fig. 14.

Plate 4.

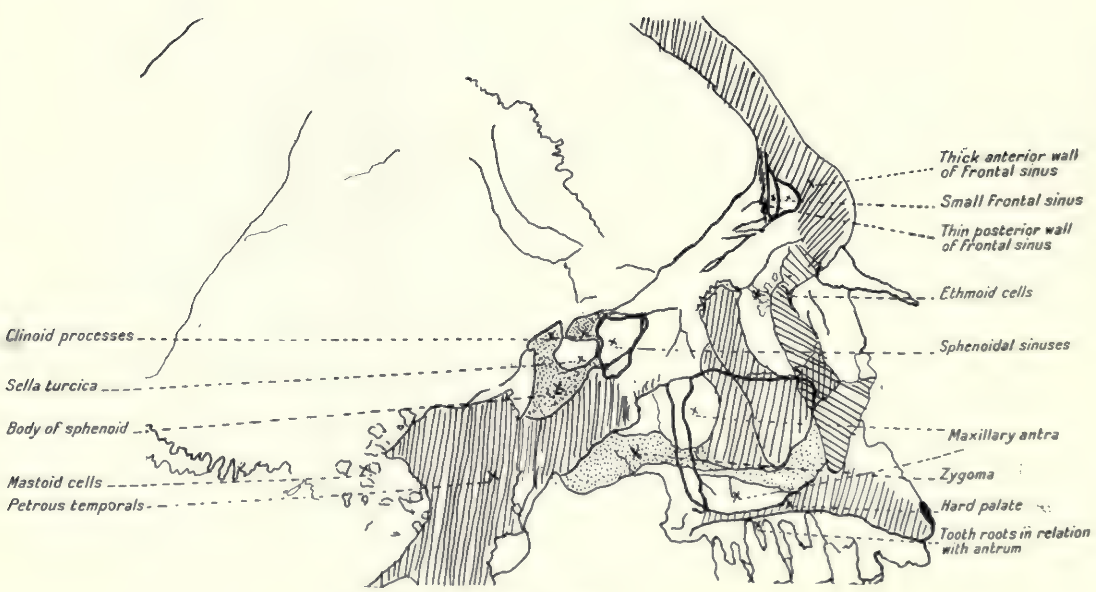

Fig. 16a.

Plate 5.

Fig. 15.

Fig. 16.

Plate 6.

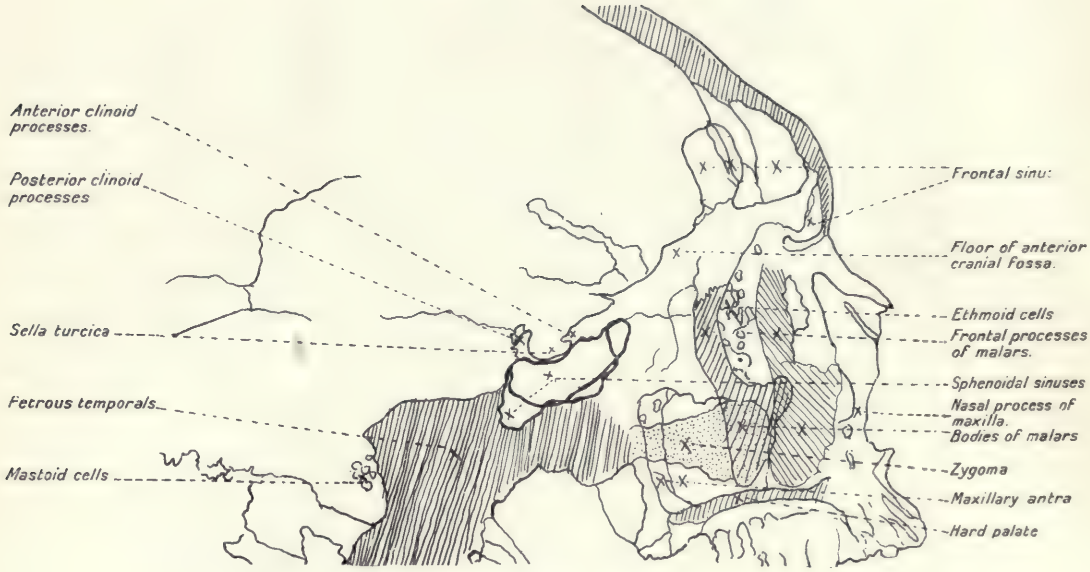

FIG. 17A.

FIG. 18A.

PLATE 7.

FIG. 17.

FIG. 18.

PLATE 8.

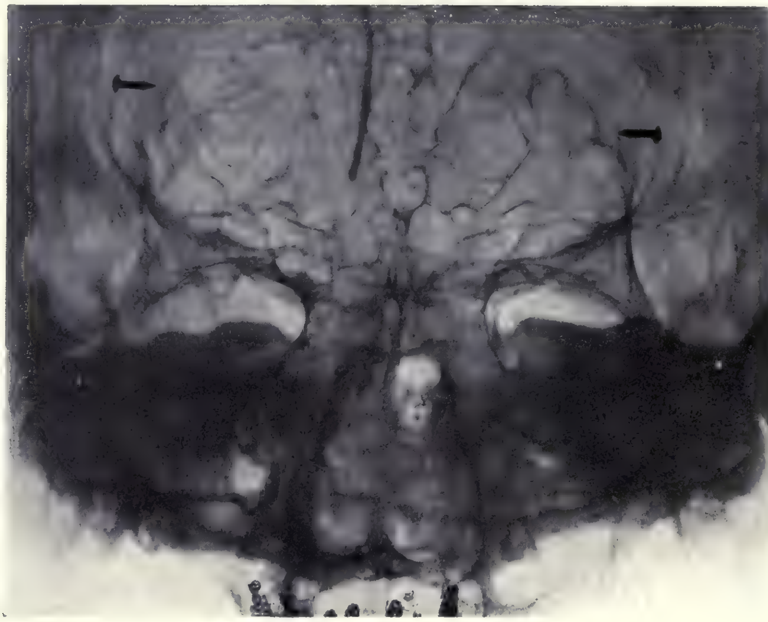

FIG. 19.

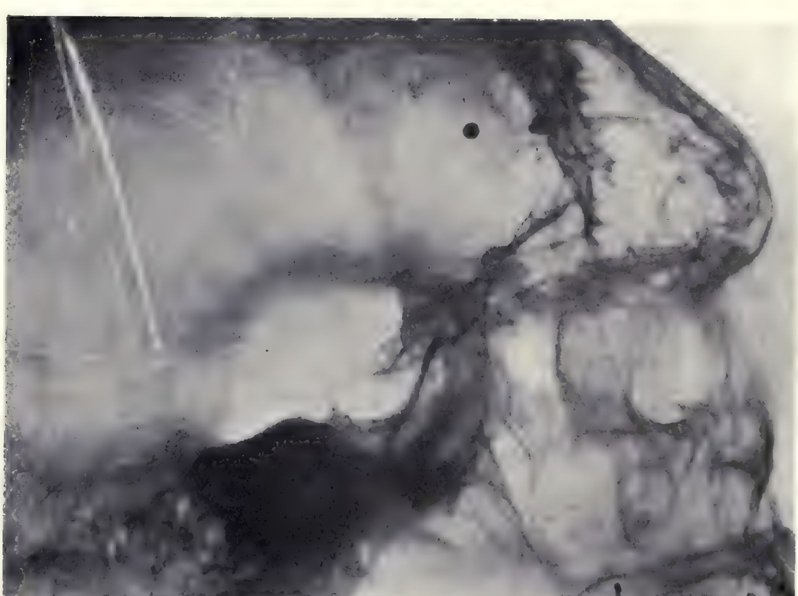

FIG. 20.

PLATE 9.

cases examined one sinus was in relation to both optic nerves—the other sinus not participating, in 2 cases out of 15 examined one optic nerve was in relation with the sinus of its own side, and the other nerve was in relation with both sinuses, in one case neither nerve had any relation with either of the sinuses. In 7 cases the relationship was fairly uniform. He found that the optic chiasma was directly on the roof of both sinuses in 5 cases, on one sinus only in 3 cases, posterior to the sinus on both sides in 7 cases, and to the sinus on one side only in 2 cases.

Onodi considers (*Laryngoscope*, 1909), that in many cases the sphenoidal sinus has nothing to do with the optic nerve, the closer connection only existing with the posterior ethmoidal cells, In my series there was a fairly close connection between the sphenoidal sinus and the optic chiasma in 40 per cent. of the skulls examined.

In radiographic examination of the sphenoidal sinuses all the positions described are required. The sinus cannot be brought close to the plate by any means, and therefore diagnosis is rendered more difficult. The position of the sinus in the postero-anterior view, and its change in position with the varying angles at which the rays traverse the head, have been already noted in the preceding article. Its position in the oblique view is shown in figure 13, whilst its normal position and size in vertical and lateral views are illustrated in figures 14 and 15, where the sinus of one side has been rendered radio-opaque in order to clearly demonstrate its location and surroundings.

In figure 12 the sinus of one side only is seen, and in figure 11, of the same skull, they are both visible: it will be noted by comparing these two illustrations that one sinus is considerably larger than the other.

In figure 16 the sinus is small and anterior to the sella turcica, whilst in figures 17 and 18 (two views of the same skull), very large sinuses are seen, extending from the basi-sphenoid behind to some distance in the greater sphenoidal wings in front and laterally.

It is worthy of note that in figure 20, where the frontal sinus is enormous, the sphenoidal is only of average size.

These two articles are an attempt to outline the technique requisite to obtain the various views which are useful in sinus examination, and to call attention to the variations commonly met with, noting also approximately their relative frequency. It is inevitable that, owing to the exigencies of space, the rarer abnormalities have been excluded, and for the same reason many of the points mentioned have not been illustrated, the figures being selected to show as great a variety as possible in each of the sinuses, and to demonstrate the most important points. As already stated, the pathological aspect will be dealt with in a subsequent article, illustrations being selected from plates taken during life.

MOVEMENTS OF FOREIGN BODIES IN THE BRAIN.

BY

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AND

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IN damaged brain matter the position of any foreign body present is likely to alter.* The heavier the piece of metal, the more likely is this to occur. This is only to be expected when one considers the fragility of the brain tissue, and further, that these cases frequently lie in one position for days at a time, thus causing a constant pressure on one spot in the brain matter through the action of gravity on the foreign body.

That such movements do occur is shown by the skiagrams of the two following cases. In both of them the wound of entrance was through the frontal bone, and in both the "drift" movement of the foreign body was

FIG. 3.

toward the occipital region, as might be expected, for in each case the patient lay for days on his back.

In case No. 1 (admitted to British General Hospital), the foreign body was a shrapnel ball. Note that the "dent" on the bullet has changed its position relative to the base of the skull (Fig. 2), showing that a considerable degree of rotation, as well as a backward movement, had occurred. The second skiagram (Fig. 2) was obtained a fortnight later. At this time it was thought that the falx cerebri had put an end to the bullet's further progress, but instead, it was found, post mortem, to be against the mesial wall of the ventricle. Skiagrams 3 and 4 were made post mortem, when the brain had

* Vilvandré. "Radiography of Gunshot Wounds of the Skull." ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY, *February*, 1916.

FIG. 1.

FIG. 2.

PLATE 10.

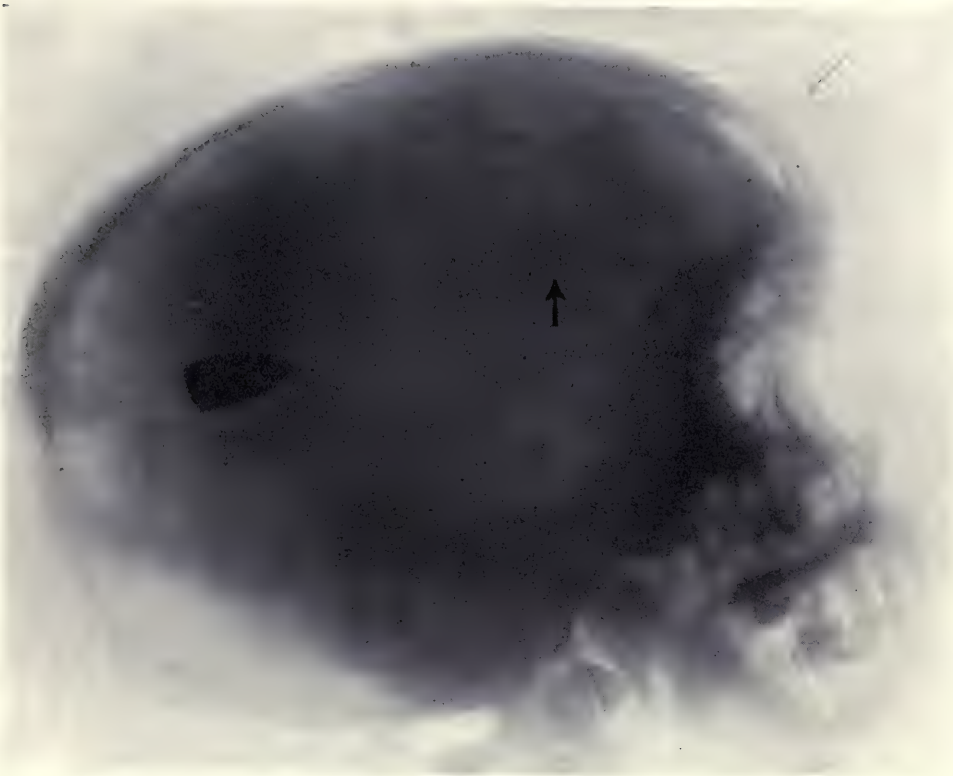

Fig. 5.

Fig. 6.

Plate 11.

been hardened in formalin for a considerable time. Thanks are due to Captains Cowper, T. T. Higgins, and Wortham for kindnesses in connection with this case.

In the second case (admitted to Canadian General Hospital) (Fig. 5), the foreign body was a sharp-nosed bullet, which lay in the right parietal lobe. The blunt end of the bullet was facing backward, outward, and slightly downward.

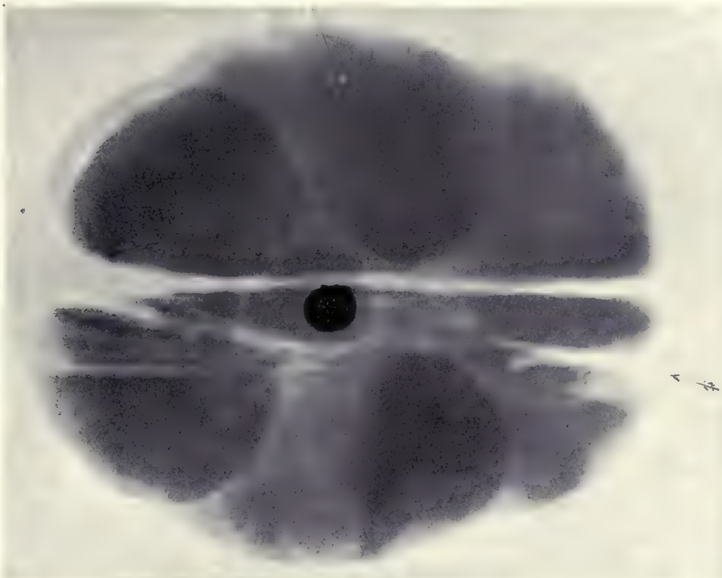

Fig. 4.

Midway between the wound of entrance and the bullet were several bone fragments.

Ten days later a second picture (Fig. 6) was taken, which showed that the bullet had sunk backwards and downward to a considerable extent. The patient died somewhat suddenly two days later.

The case was sent in by Major Philp and Captain Burke.

X RAYS AND RADIUM RAYS IN THE DIAGNOSIS AND TREATMENT OF ENLARGED LYMPHATIC GLANDS.

During the course of investigations extending over many years into the action of radiations upon tissues, the behaviour of enlarged lymphatic glands, of whatever nature, towards the action of radiations is such as to make a deep impression on the impartial observer.

The particular type of radiation employed has been, latterly at least, a moderately hard X ray.

Radium has also been used in a number of cases, the gamma ray being chiefly employed, with a filtration of 3 or 4 mms. of lead, or 1 to 2 of platinum when applied from the skin surface.

The response has been marked in both types of radiation, it being only a matter of selection of ray to suit the particular case undergoing treatment. This selection has been empirical up to the present, but with increasing experience and accurate estimation of the wave length of the radiation employed, it should be possible to specify both the wave length and to prescribe a definite duration of time necessary to produce a given effect.

Moreover, it is possible to classify the different types of enlarged glands and formulate a scheme of radiation exposures which will be curative in effect, and also valuable from a diagnostic point of view.

In regard to this latter point, it is well to call attention to a field of usefulness for radiations which, up to the present, has somewhat escaped notice, that is, the value of X rays in the diagnosis of disease by noting the reaction in the glands to radiations and the subsequent diminution in size as a result of treatment in contra-distinction to the generally accepted method of diagnosis by visual demonstrations upon the screen and photographic plate.

The particular diagnostic point to which attention should be drawn is that while making use of the therapeutic action of X rays in treating enlarged glands, advantage should also be taken of their diagnostic value in establishing the cause of the enlargement, it being a matter of common experience in the treatment of these glands that nearly all types are influenced in a definite ratio, according to the exciting cause.

It may be stated as an established fact that enlarged glands respond to radiations in the following order :—

(1) *Simple Inflammatory Glands*—quickly influenced by a few exposures. This is not applicable to enlarged glands in which the inflammatory process has passed on to the formation of pus.

(2) *Lymphadenomatous Glands* — less quickly acted upon, but almost invariably diminished in size, quickly, after a number of exposures to hard radiations.

(3) *Tuberculous Glands*—not readily affected. It requires a large number of exposures at short intervals to induce retrogressive changes, but ultimately these also slowly respond to radiation treatment.

(4) *Malignant Glands*—are also influenced. Sarcomata are much readier in their response than carcinomata ; they may disappear, but are apt to recur. Carcinomatous glands are the slowest of all to be influenced, and rarely disappear under treatment : they may, however, diminish considerably in size.

Taking this response of enlarged glands to radiation treatment, the following table may be constructed :—

(1) *Inflammatory Enlarged Glands*—very rapid response.

(2) *Lymphadenomatous Glands*—rapid response.

(3) *Sarcomatous Glands*— rapid response, sometimes almost as rapid a diminution in size as in the case of simple inflammatory glands, but the effect is rarely permanent, there is a tendency to recurrence, and an ultimate refusal to respond to further treatment.

(4) *Tuberculous Glands*—slow response. As a rule, they slowly subside and become quiescent, but very rarely entirely disappear ; they tend to become active again after longer or shorter intervals. From the point of view of treatment it is well to remove the glands after they have become quiescent.

(5) *Carcinomatous Glands*—very slow response. They hardly ever disappear or become quiescent ; it is better, therefore, to remove them whenever possible, even after prolonged radiation treatment.

(6) *Enlarged Glands due to a Mixed Infection.*—Enlarged lymphatic glands are met with in various parts of the body, and are usually due to one of the foregoing causes ; but it must be clearly realised that the predominant cause need not necessarily be the only one ; cases occur where there is a mixed infection, and these cases will, at times, behave in a manner which is disconcerting when an attempt is made to classify the type of gland according to the response to treatment, either by drugs or radiations.

The two groups where this disturbance is likely to occur are (1) the tuberculous, and (2) the malignant.

In the former it may be that only a percentage of the glands are infected with tubercle, the others being enlarged in consequence of some other infective process, or the tuberculous infection may be implanted on glands which are already enlarged from a septic focus somewhere in the area drained by the same lymphatics ; the response to treatment may then be irregular, a number of the glands subsiding rapidly, whilst others respond very slowly.

In the case of malignant glands it is not at all uncommon to find a number of glands enlarged where no trace of malignancy can be detected histologically ; here again, a mixed response will follow on treatment, the non-malignant glands responding rapidly, while the malignant ones show scarcely any change after many radiations.

In the purely malignant glands the degree of involvement of the gland by malignant cells will also influence the result of treatment—such a gland may have only a very small focus of infected cells, the greater bulk of the enlargement being composed of inflammatory products, which are reactive in nature to the invading malignant cells—here radiation treatment will aid the reactive process, and lead to the arrest of the extension of the malignant cell area, and ultimately cause their disappearance in fibrous tissue.

Taking these facts into consideration, it appears that the use of X rays in diagnosis might be extended to all doubtful cases of enlargement of the glands. A definite number of exposures might be given at stated intervals, and the reaction of the glands to the radiations taken as an indication of their nature. This would in no way interfere with other methods of investigation, or it might be carried out concurrently with them, a therapeutic agent of great potency being applied, which is very likely to do a considerable amount of good, markedly so in improving the general health and tone of the patient.

This method of investigation can be applied to all parts of the body, for

with modern technique it is possible to obtain a therapeutic effect at any depth of tissue.

In selected cases other methods can also be employed at intervals corresponding to the periods of radiation exposures. Blood investigations would be most useful in these cases, for we could then observe the effect of the exposures upon the differential blood count. Much valuable information would accrue from this combined method.

In order to render the method practical it would be necessary to standardize the exposures to suit all cases. One month might be selected as the time factor, a definite dose or doses divided into two or four units being given —that is to say, one dose in a fortnight, or better, a weekly dose of say 7X through a 3 mm. filter of aluminium—the dose is measured on the skin surface, a definite hardness of tube being maintained. The distance of the anticathode from the skin or gland must be the same in all cases.

Another method would be to arrange that the particular group of glands involved should receive a definite dose ; this would avoid several conflicting factors. In this method the time factor in dosage would vary with the depth of the gland from the skin surface.

In deep regions it would be necessary to protect the skin if a fixed tube is employed ; if a rotating tube is employed the dose can be projected on to the gland by using one or more skin circles, the rays converging upon the gland in the interior of the body. The skin by this method receives a minimal dose and rarely requires a filter, or at most a filter of 1 mm. aluminium can be employed as a measure of safety.

It is merely a matter of experiment and calculation to estimate the dose at a depth from the effect of the rays upon the skin surface, so that it would be possible to administer the same dose of radiations to glands in all parts of the body. In estimating the reaction to radiations there are certain factors, apart from those which complicate radiations, which require consideration. The biological factor is of some importance, and this will always be a disturbing element in all estimations ; it is never constant, but varies in individuals, and even in the same individual at different periods. This is a factor which must always be considered as more or less unstable. The experienced radiologist soon becomes able to give this factor its proper value in all experimental work.

The tissues vary in their response according to the conditions which influence them in physiological processes. It is probable that the reaction varies with the proportion in the tissues of elements likely, when themselves bombarded with radiations, to give off secondary radiations.

In diagnosis it is important to know what drugs have been administered, and particularly if iron, arsenic, or mercury, have been used. It is found, for instance, that if mercury and arsenic have been used intravenously, *i.e.*, salvarsan, or one of its substitutes, that the response to radiations is much more active and pronounced than when it has not been used. Similarly, an excess of iron in the blood leads to a more marked response, and it is possible

that there are many other inorganic compounds which may affect the response of the tissues to radiations.

It has been found in therapeutics, when treating lymphadenomatous glands with arsenic and X rays, that a most marked effect is produced quickly, the glands diminish very rapidly in size, and if care is not exercised the general condition of the patient may be seriously aggravated.

Similarly, in certain diseases of the blood, serious effects may be induced if the radiation dose is too great.

In practical therapeutics the radiation treatment of enlarged glands should find a useful field of action ; all cases which refuse operation, or in which, from the extent of the disease, a very extensive operation would be required, should receive radiation treatment as a matter of routine. It may be possible, at the worst, to reduce the glands to a size which renders operation feasible and safe. In a number of cases the glands are reduced to a very small size and the patient restored to good health.

In the simple inflammatory type the argument may be advanced that these glands frequently do as well when no radiation treatment has been employed. With that argument I am in complete agreement ; but I have also seen a large number of cases which persistently remained enlarged until a few radiation exposures had been made, when they quickly subsided. Lymphadenomatous glands respond readily to treatment, but the tendency is for recurrence to take place at a later date. This recurrence may be postponed if the treatment is continued at long intervals, care being taken to see the patient from time to time, in order to treat at once if the glands show a tendency to enlarge. It is a matter of general experience that patients who have been treated by radiations appear to require an occasional dose at intervals to keep up the action. They appear to miss the stimulation which they receive from the radiations.

Tuberculous enlarged glands require to be treated at frequent intervals over a long period of time, but there can be no doubt that these cases do receive a considerable amount of benefit both locally and constitutionally.

In so far as the majority of patients with enlarged tuberculous glands in the cervical region have also evidence of enlarged glands in the thorax, and many show well marked tuberculous lesions at the roots of the lungs, it is good practice to submit the thoracic glands to the radiations ; marked benefit will follow.

A useful extension of X-ray treatment would be the treatment of all available cases in sanatoria by systematic irradiation of the cervical regions, axillæ, and roots of the lungs, from several aspects. This would be useful as a general tonic, and would undoubtedly lead to improvement in the general condition of the patient. This would particularly apply to the subacute and chronic cases where the glands are involved and where the reactive power of the tissues is marked. Prolonged treatment is necessary, and where this has to be carried out over many months it is well to suspend treatment at intervals, and give the superficial tissues time to recover from the effects of over

exposure. With the thick filters now in use this effect is becoming more and more rare.

When a group of enlarged glands has been reduced to a moderate or small size, the question should be raised as to the expediency of operation. It is a common experience to reduce these glands to quite a small size, but they are hardly ever so reduced as to be barely palpable, and a quiescent gland is always a potential source of danger. If the screen picture shows no trace of lung or glandular involvement, then in view of the possibility of a late dissemination of the disease, it would be well to remove the glands thoroughly—the treatment will have had the effect of strictly localising the group and thus permitting of a safe removal.

In a number of cases it will be advisable to give post operative treatment—this will serve a twofold purpose, it will secure a sound pliant scar, and should aid in the prevention of recurrence, or rather check the development of the disease in small glands which have escaped removal.

Malignant Enlargement of Lymphatic Glands.

The commonest conditions are sarcomata and carcinomata. They may be primary, but are generally secondary to a lesion elsewhere. In such cases X rays may be profitably employed in diagnosis, and in treatment. In the former capacity a thorough search may reveal the site of the primary lesion: in the latter it may be possible to reduce the gland to an operable condition, or if the condition is inoperable, to arrest the inevitable progress of the disease for a time, or to give relief from distressing symptoms, such as pain, ulceration, etc. No case of carcinoma of the glands should be treated until a surgeon has decided that it would be unwise to operate, and, in so far as these glands are usually secondary, it would be useless to operate unless the primary lesion could also be removed.

The treatment of secondary carcinoma of the lymphatic glands must be carried out thoroughly and persistently—it must cover the whole area of glandular involvement and the lymphatic distribution in the region of involvement.

When the glands are considerably enlarged the prospect of diminution is remote, so it is sound practice to remove all within reach and irradiate the site of operation in the hope that glands affected, but not yet enlarged, may be rendered inert. It may be necessary to remove repeatedly glands which threaten to get beyond the control of the radiations. I am convinced that if the radiologist and the surgeon work together the result of the combined treatment is infinitely better than that obtained by either acting alone. I have seen a number of cases where the combined treatment resulted in periods of immunity which would otherwise have been unattainable. Any case which is within the range of operation should be so treated, and thorough irradiation carried out afterwards. By holding out a prospect of help after operation, the surgeon may be encouraged to operate upon what he would otherwise regard as a hopeless condition.

In a number of cases radium may be more suitable than X rays, or the two types of radiations may be used together or alternately, and when an operation has been performed and it has not been possible to remove all of the glands or growth, radium tubes may be inserted into what remains, and left for a suitable time. The question of technique comes in here, as to the type of ray to be employed, and the duration of the exposure. These are questions which can only be answered as the results obtained dictate. In a number of cases tubes containing radium emanation may be inserted into the growth, thus ensuring an even distribution of the radiation. A thin filter is employed in these cases; $\frac{1}{3}$mm. of platinum may be used in particular cases. Radium may also be employed from the skin surface; thicker filters will be necessary if long exposures are contemplated—the action on the skin must be kept in mind when treating from the surface.

In the treatment of malignant glands by radiations, we can unhesitatingly state that many cases receive material benefit, a few appear to be cured for a time at least, and there is no doubt that when the treatment is combined with the operative method many patients are saved much pain and distress from ulcerating discharging sores. In a small percentage of cases a cure may in the end be obtained, often in cases which did not offer any hope of success.

These methods of treatment by X rays and radium are at present in their infancy. With increasing experience and improvements in technique it may be safely assumed that the percentage of cases which receive benefit will increase. Earlier treatment, both surgical and by radiations, should also lead to an improvement in results.

The point to insist upon is that there is no antagonism between the two methods of treatment: neither is specifically a cure, treatment by radiations never has been, and in all probability never will become a specific cure for malignant disease, but when surgical interference, radiation treatment, and tonic treatment by drugs, are employed in combination, we do possess means of combating this disease which render the effort well worth the making, all the more so because we treat with the conviction that we can do a great deal to help the patient himself to combat the disease.

No measure which holds out any prospect of success should be neglected in these desperate cases which so often call for treatment; the mere fact of trying helps the patient greatly, and may at times give him the necessary incentive to help himself. In our conflict with malignant disease, especially in these desperate cases, everything counts, and no effort is wasted.

R. K.

REPORTS OF SOCIETIES.

RÖNTGEN SOCIETY

PROTECTION OF THE X-RAY OPERATOR.

At the meeting of the Röntgen Society on February 1st, a discussion took place on the subject of the protection of the X-ray operator. Dr. Sidney Russ, the opener, said that the dangers belonged to two classes, namely, the obvious and the hidden, and among the latter were the blood changes which occurred after undue exposure. Investigations had shown that the red-cell content in the blood of X-ray workers was below the normal, and in very many cases the white-cell content—markedly the lymphocytes—was below the normal also. On the general question, Dr. Russ pointed out that while in one direction X-ray dangers were becoming less formidable owing to the general dissemination of the knowledge of them, yet in another the peril was becoming greater because of the ever increasing puissance of the X-ray outfit. If any other means of ensuring efficient protection could be secured, it would be an advantage not to invoke legislation, for of all the methods available, legislation would be the least popular and the least convenient. Sir James Mackenzie Davidson related how in the early days he had enclosed the tube in a wooden box coated on its inner side with a putty made up of white and red lead, a hole being cut in the lid, against which the anterior part of the tube was secured by elastic bands. With an increased amount of screen work, he followed the plan of placing a thick lead barrier around the tube, the observer standing completely behind it, and watching the reflection of the screen image in a fine plane glass mirror placed at an appropriate angle. Mr. H. E. Donnithorne dwelt upon the dangers of secondary radiation, and suggested that even protective devices might furnish additional dangers, as in the case of a couch which had a protective metal surface just grazed by the emergent radiation. The effect, he believed, was to excite secondary rays, and to increase the peril of the operator. Dr. G. H. Rodman suggested that the General Medical Council be asked to take up the question, and include X rays in the medical curriculum. Before a man was allowed to qualify, he should be made as fully acquainted with the dangers of the X-ray tube as he was with the dangers of strychnine. X-ray dermatitis, Dr. Rodman added, yielded to the influence of sunlight and fresh air, and by that means, as well as the avoidance of the X-ray tube as much as possible, a patch of dermatitis on his own hand had practically cleared up.

Dr. Fred Bailey, of Brighton, had found a certain amount of anæmia among persons constantly receiving X-ray treatment for malignant disease. For protection he barricaded himself behind a large screen running on castors, and enclosed the tube in a lead glass bulb also. There remained, however, the ionization of the air, which was quite possibly dangerous to X-ray workers. Dr. Reginald Morton was sceptical as to any effect of secondary radiations, as these had yielded so little in therapeutics that was conclusive. Nor did he regard X-ray effects as steadily and consistently cumulative. A man was capable of receiving a certain dose of X rays and making a complete recovery, suffering no permanent disability. The ionization of the air was a possible theory, and after an afternoon spent in X-raying many cases, he had a very great sense of fatigue. On this same question, Dr. Harwood Nutt thought that the effects of atmospheric ionization might be prevented by having not one, but two ventilators, thus ensuring a constant current of air passing through the X-ray room. Dr. N. S. Finzi mentioned that one of his assistants had placed a little enclosed pastille on the front, and another on the back of his protective apron. The pastille in front turned to the "B" tint in ten days or a fortnight, the operator working with the X rays every morning and four afternoons a week. The pastille on the back of the apron was not more than half turned after six weeks. A pastille dose in three months did not seem likely to do the operator any harm, even if continued over a long time. Dr. Herschell Harris thought that the glass supplied for protective purposes was faulty. Often it was not lead glass or X-ray proof at all. The

makers should be asked in all cases to notify their customers as to the quality of the glass. Dr. Harris urged the use of the old-fashioned long apron.

The discussion was adjourned until the March meeting.

RÖNTGEN SOCIETY

ADJOURNED DISCUSSION ON THE PROTECTION OF THE X-RAY OPERATOR.

At the March meeting of the Röntgen Society the discussion on X-ray protection, adjourned from the previous meeting, was resumed. Dr. W. Harwood Nutt brought forward various figures to illustrate the efficiency of certain materials used for the protection of the X-ray operator. Among other things, he showed a glove which allowed more than 50 per cent. of the rays to penetrate. He thereupon made a cover for the glove in the shape of a strong piece of leather, which had no separation for the fingers. When the glove was placed in the cover, only 1·75 per cent. of the rays was able to get through. At first such a glove cover might be thought to impede the movements of the hand, but really it worked with a fair amount of ease. Dr. Nutt also brought forward some qualitative observations which seemed to show that the tired feeling experienced by X-ray workers was due to ozone generated by the X-ray tube.

Mr. W. E. Schall put in a plea for the manufacturer, and said that while undoubtedly there was room for improvement, yet until the manufacturer was definitely told what was expected of him and what he must guard against, and before certain of the physical problems surrounding the subject had been more adequately studied, he was in a difficult position.

Dr. G. B. Batten drew attention to the fact that certain chemical agents were liable to exacerbate an X-ray reaction. The only case of dermatitis in ringworm, within his own practice, was one in which the head had previously been treated with picric acid. The developing agents used by radiographers were a possible source of danger.

Major Wilson, a Canadian guest, pleaded that some *ex cathedra* pronouncement should be made by the Society and submitted to the War Office. Speaking of his own experiences in connection with the Canadian hospitals at the front, he said that certainly the ideas of British manufacturers with regard to protection were below the standard which was deemed necessary with the heavy transformer outfits obtained from the United States and Canada. They now insisted upon all the hospital X-ray departments being protected with 8 lb. lead, where possible in a double thickness.

Mr. T. Clarke said that he had worked for twenty years with static machines, and for the last sixteen years had been exposed for thousands of hours to X rays thus generated, while he had had no protection whatever. No damage had resulted, and he suggested that there was one particular order of rays, emanating from a tube when excited by an induction coil, which did not exist in the case of X rays excited by a static machine, and that it was these rays which did the damage.

Letters were read on the subject by Mr. C. R. C. Lyster, and Mr. Charles A. Schunk, and then Dr. Sidney Russ replied to the various speakers seriatim, and speaking with regard to the last point, raised by Mr. Clarke, said that he could see no reason why, if the potential difference between the electrodes was the same, there should be any appreciable difference in the character of the rays issuing from a tube generated by a static machine, from the ray issuing from a tube generated by the induction coil.

The President announced that the authorities of the National Physical Laboratory were prepared to examine, and to give a certificate upon protective materials submitted to them.

Previously to the discussion, Mr. Gunstone read a paper and gave a demonstration on a method of utilizing the reverse current, and showed the results of some photographic tests, to prove how efficiently the action desired was brought about.

REVIEW.

Essentials of Medical Electricity. By E. R. Morton, M.D. (Trin. Tor.), F.R.C.S. (Edin.), and E. P. Cumberbatch, B.M. (Oxon.), M.R.C.P.(Lond.). Third Edition, revised and re-written, with the addition of new matter by E. P. Cumberbatch. Published by Henry Kimpton, London. 1916. Pp. 303. Price 6s.

This book is just what it claims to be. It gives the student the essentials of medical electricity, and it will form a practical guide for workers in the Electrical Department of any General Hospital.

Medical electricity is in a state of flux, or, rather, of almost too rapid development, and the data contained in the classical works on the subject have to be re-read in the light of modern theories of electricity and the wider scope of physical therapeutics. In both of these directions the reader will find an up-to-date guide in Dr. Cumberbatch, upon whose shoulders has fallen the mantle of the late Dr. Lewis Jones, his predecessor at St. Bartholomew's and the father of scientific medical electricity in England.

The new edition of the *Essentials* has been enlarged and completely re-written, so that it is really a new book. The subject has been presented in a new way. A preliminary description of the various ways in which electricity acts as a therapeutic agent is followed by an account of the various electrical currents used in medicine and the sources of supply that are available to the practitioner. Then follow chapters on ionisation, high-frequency, diathermy, static electricity, and the use of the electrical currents for testing the reactions of muscle and nerve. A short account of the new method of testing, viz., by condenser discharges, has been added.

The chapter on diathermy gives an up-to-date description of the apparatus and *modus operandi* of this electric modality. Here, once more, we find evidence of the urgent need of further research to enable us to perfect this comparatively new weapon in the hands of the electrologist. Whether, as the author says, the benefit is due to the production of heat in the deeper tissues, or whether we are in presence of some deeper and more mysterious action of the ethereal wave, the heat developing, as it were, a bye-product, is yet a moot question. Many and diverse as are the diseases in which diathermy has been proved of use, one of the most important, according to Nagelschmidt, is angina pectoris. It is curious that more than 150 years ago, John Wesley, who was greatly addicted to the use of electricity, relates a case of angina pectoris treated and cured by what we now sometimes call "Franklinisation."

An alphabetical index of the diseases in which electricity will produce good results has been added, and the concluding chapter has been devoted to an elementary exposition of the physical principles of electricity.

One caution should be given. "Festina lente" should be more especially the motto of the medical electrician. Much good may be done by gentle and properly graduated doses of ethereal waves, nothing but harm can result from rough and rude electrical stimulation of diseased joints and degenerating tissue in patients debilitated by illness or age.

We may congratulate the Electrical Department of St. Bartholomew's and the English School of Physical Therapeutics on a work like this, a work which should be in the hands of every student of medical electricity, a work which has been produced during the storm and stress of war. W. D. B.

NOTES AND ABSTRACTS.

RADIOGRAPHY

Some X-ray Observations Concerning Gastrospasm and Gastric Atony.—By Sidney Lange, M.D. *Lancet-Clinic*, February 13th, 1915.—The normal stomach when empty is a small collapsed bag. The unfolding of this collapsed bag can be observed by the X ray. If into such an empty stomach a watery suspension of bismuth or barium be introduced and its path observed by the X ray, variations

from the normal can be detected, and if these variations are properly interpreted they may suggest one or other of the gross lesions of the stomach wall.

When the food enters the cardia it does not fall into an open space, but it normally finds an enthusiastic muscular reception. The normal stomach is as large as its contents. After the distention reaches a certain degree, peristalsis begins. The peristaltic waves slowly pass the contents of the cardiac portion of the stomach into the pyloric portion. When the antrum pylori is reached the food does not immediately pass out of the pylorus, but it suffers a retrograde movement as the waves impinge upon a closed pylorus, and after travelling back and forth in the pars pylorica and antrum pylori it finally escapes through the pyloric sphincter. As peristalsis progresses the waves become deeper. Often the waves are unusually deep and numerous, and the stomach tightly contracted about its contents. Such a stomach is said to be a hypertonic stomach, and to exhibit hyperperistalsis. But hypertonicity and excessive peristaltic activity are not synonymous with rapid clearance. A consideration of the stomach clearance introduces another factor, namely, the pyloric sphincter.

Now, in so far as the X-ray plate shows definite outlines of an actual stomach contour existing at the moment of exposure, it is an accurate and valuable record. But the great danger in the reading of X-ray plates is that the psychological aspect of gastric activity may be disregarded. The stomach activity is only apparently mechanical; really it is dependent upon nervous control. The evaluation of the nervous control is all important.

X-ray observations upon the stomach have given a new significance to two types of abnormal nervous control of the stomach. In one type the tonus of the gastric musculature is subnormal. This is the rather ill-defined clinical condition known as atony. In the other type the tonus is abnormally high, often resulting in an actual spasm of the gastric musculature. Clinically this condition has been partially and inadequately recognised as hypertonicity and pylorospasm. To this condition of excessive gastric tonus the roentgenologist has applied the term gastrospasm.

The frequency of the occurrence of gastrospasm is surprising to one making routine X-ray examinations of the stomach. Hyperacidity is the favourite explanation for the condition, just as it serves to explain any other stomach symptom. Recent observations show that hyperacidity is not a necessary accompaniment of gastrospasm or pylorospasm, and is not a constant factor in the etiology of such spasms. Analogous to hysteria, gastrospasm may simulate radiographically any gastric disease. It may produce a contraction of the entire stomach and partially or completely obliterate the lumen. The spasm may, however, produce little or no diminution and distortion of the lumen of the stomach, but may simply stiffen the walls and thus interfere with peristalsis. Commonly only a small part of the stomach is involved, as, for instance, a small area on the greater curvature producing the pseudo or functional hour-glass contraction. Again, only the pylorus may be involved, producing the so-called pylorospasm. The antrum pylori or the entire pars pylorica is frequently involved, resulting in grotesque distortion or obliteration of the lumen of this part of the stomach. Here a single X-ray plate or fluoroscopic examination may lead to an erroneous diagnosis of gross organic disease, while the varied symptomatology that goes with gastric neuroses may seem to confirm it. Many such cases are of reflex origin from a lesion in the duodenum or gall passage, demanding surgery.

Gastrospasm is, of course, distinct from hypertonicity. The latter is always accompanied by normal or increased peristalsis. With gastrospasm there is no peristalsis. Furthermore, gastrospasm is usually confined to a small area, while hypertonicity, as a rule, affects the stomach as a whole. Hypertonicity represents an exaggerated enthusiasm of the stomach for its food; gastrospasm represents an excessive and abnormal enthusiasm.

When the spasm affects the pyloric ring, new difficulties arise for the roentgenologist. The stomach may be seen to exhibit active peristalsis, and the waves are deep and numerous, yet none of the food escapes from the pylorus. An examination at the end of six hours may show a large residue. The question of differentiation of pylorospasm from pyloric

stenosis arises. If the X-ray examination reveals an actual fixed gross deformity in the region of the pylorus the diagnosis of organic stenosis may be readily established. But when stomach outlines and activity appears normal, yet manifesting delayed clearance, the problem of distinguishing at once by the X-ray method a narrowing of the pyloric ring from a pyloric spasm is not an easy one. Owing to the frequency of pylorospasm, the value of delayed clearance as determined by finding a residue six hours after taking the opaque meal, is often uncertain. Holznecht's symptom complexes, which he formulated for the X-ray diagnosis of gastric lesions, were based largely on the time of clearance. It is, of course, well known that a simple pylorospasm may cause retention of the food for twenty-four hours.

To guard against such error as might arise from the misinterpretation of spasmodic conditions of the stomach, repeated examination at different times and under different conditions may suffice. Very valuable is the use of atropin to dissipate the spasm. More recently Holznecht has introduced the use of papaverin to differentiate between gastrospasm, pylorospasm and organic lesion of stomach proper and pylorus. Papaverin is not a new drug, and its physiologic effect has up to this time been considered unimportant. Its unique action upon the stomach musculature, as recently discovered by Pal, makes it of apparent value in the roentgenologic dilemna. Pal showed that in physiologic doses (one-half to one grain), the tone of the involuntary muscle fibres (both circular and longitudinal) of the stomach is lessened, especially if the tone be abnormally high. Atropin also will do this, but papaverin, according to Pal, has a special advantage over atropin in that it leaves peristalsis unaffected. Hence it should serve admirably to make the differentiation between pylorospasm and pyloric stenosis. It eliminates spasm and leaves peristalsis unaffected to show the actual patency of the pylorus. Authoritative clinical confirmation of the above described action of this drug is as yet lacking.

Clinically, such a differentiation often may be made by varying the diet and the psychological influences attending the taking of food, and it is here that the clinical methods have some advantage. The X-ray opaque meal must always be more or less distasteful, no matter what vehicle is used, and it cannot be varied widely. It is, moreover, usually given in strange surroundings. Just recently I saw a case in which, during the hour occupied by the X-ray examination, practically no opaque food passed through the pylorus, but when the patient was placed at rest in bed on a carefully selected diet, there was no retention.

The term atony, like the terms pylorospasm and hyperacidity, has been frequently misused. Clinically, atony has heretofore been recognised by delayed clearance, as determined by the stomach tube. But atony can exist in a stomach that empties itself within the six-hour limit. Atony, from the X-ray standpoint, means that the stomach has not its normal tone. It has lost much of its reserve power and will exhibit ruptured compensation upon slight provocation, as evidenced by delayed clearance. Clinicians often make the statement that, so long as a stomach empties itself within six hours after a full meal, it is a normal stomach no matter what its size, position, or peristaltic activity may be. Yet they would not call a heart which is enlarged and has lost much of its reserve power a normal heart just because it is at the present moment emptying itself at each systole. An atonic stomach is not one in which there is necessarily a six-hour residue, but it is a stomach whose mechanical power is subnormal; it will suffer ruptured compensation, leading to temporary dilatation and retention, upon a slight provocation. Such a stomach usually produces symptoms of some sort, although not necessarily referred directly to the stomach.

As conceived in this way, atony cannot always be recognised clinically, whereas the X ray provides a ready means of making the diagnosis. The atonic stomach, as recognised radiographically, is a long-stretched stomach into which the food drops as in an empty sac. It fails to grab the incoming food; that is, its peristole is deficient. The food sinks into its caudal pole, and the continued addition of food fails to fill it. It is so stretched by the weight of the food that its walls between the gas bubble in the upper pole and the food in the lower pole collapse. It usually exhibits

few or no peristaltic waves. If present they are usually shallow. The antrum pylori fails to form distinctly. It may, however, empty itself fairly well. The atonic stomach maintains its characteristic tubular form although stretched. This picture is to be distinguished from dilatation, in which condition the stomach appears as a shapeless bag with increased horizontal dimensions, and in which the food lies as in a large bowl. There always is marked retention in such a stomach.

Atony, then, from the X-ray standpoint, is a lack of enthusiasm of the resting stomach for its incoming food. Whether the atonic stomach empties itself promptly or slowly does not enter into the matter. An atonic stomach may exhibit active, deficient or no peristalsis. Any type of peristalsis is, however, mechanically inefficient in an atonic stomach for obvious reasons. Though the peristaltic waves be numerous and deep, the failure of the stomach to contract tightly about its contents nullifies to a greater or less degree the propulsive effect of the waves. The clinician usually associates deficient peristalsis with gastric atony, and often the terms are used synonymously. Gastric peristalsis is initiated and controlled automatically by the nerve plexuses in the stomach wall. Gastric tonus depends upon vagus impulses for its maintenance and control. Tonus varies from day to day within wide limits and is profoundly influenced by the temporary fluctuations of the central nervous system and by the state of general bodily health. Peristalsis, on the other hand, is called forth automatically by certain local stimuli, such as the presence of food in the stomach. In marked atony the stomach walls may be so stretched that the efforts of the muscles to produce peristaltic waves become totally ineffectual. In gastrospasm the excessive tonus may so stiffen the stomach walls that no peristaltic waves can form. It is thus apparent that both diminution of tonus and excess of tonus (gastrospasm) may interfere with peristaltic activities and tend to delay clearance.

In the light of the roentgenologic conception of gastric tonus, the term atony (implying total lack of tone) is a faulty one, as commonly used. In designating a stomach as atonic the clinician usually means that the stomach has a lowered or deficient tonus. It is a hypotonic stomach, not an atonic one. With respect to tonus, the stomach, as revealed by the opaque meal and the X ray, has been classified into the following types: Hypertonic; orthotonic (normal); hypotonic (clinically termed atonic); atonic (clinically termed dilated). The atonic stomach, strictly speaking, is the grossly dilated organ manifesting an extreme degree of retention.

With respect to etiology, gastrospasm and gastric atony have much in common in that they may be produced by analagous causes.

Gastrospasm may arise from such general nervous states as hysteria, intoxications, lead poisoning, etc. It may be a local expression of a disease of the central nervous system, such as tabes. The presence of gastrospasm has several times called my attention to the presence of an ill-defined tabes. The tabetic gastric crisis is a gastrospasm. Excessive nervous excitement such as develops in nervous patients during an X-ray examination may produce gastrospasm. Gastrospasm may result from local causes in the stomach, such as ulcer, ulcer scars, adhesions, etc., or it may be produced by local conditions outside the stomach, such as duodenal ulcer, gall passage lesions or irritation about the appendix. The reflex vomiting of gall passage lesions and disease of the appendix is a type of gastrospasm. The small, hypertonic stomach, which has been recognised by roentgenologists as a classical accompaniment of duodenal ulcer, is an expression of this tendency.

Atony of the stomach similarly may arise from general nervous states, such as neurasthenia, psychasthenia, worry, etc. The most common cause is a state of lowered vitality of the nervous system such as accompanies tuberculosis, intestinal auto-intoxication, etc. Many patients presenting the so-called "habitus enteroptoticus" have a more or less atonic stomach.

Local conditions in the stomach are less common causes of atony. Atony is rarely due primarily to obstructive lesions at the pylorus or in the duodenum. With such lesions a condition of hypertonicity with hyperperistalsis usually develops. Late in the course of obstructive lesions atony may supervene, but this usually takes on the character

of a true dilatation with loss of the characteristic stomach configuration (the true roentgenologic atony).

Atony may result from lesions about the gall passages or appendix. I have seen cases of verified chronic appendicitis present the fluoroscopic picture of atony, but perhaps a greater number of cases of chronic appendicitis are accompanied by the hypertonic stomach with a tendency to gastrospasm.

The nervous mechanism producing these phenomena is not clearly understood, but may be explained by a disturbance—either directly or reflexly produced—of the balance between pneumogastric and splanchnic impulses.

The purpose of this paper is to call attention to a source of error in the interpretation of roentgenograms or fluoroscopic outlines of the stomach, and to the fallacy of drawing hasty conclusions from appearances seen on a single X-ray plate or during a single X-ray examination. Just as the clinician requires a period of time for the study of a case, so the roentgenologist often requires a similar period of observation in order to make a thoroughly trustworthy diagnosis.

The Localization of Foreign Bodies.—(*Bulletins et Mémoires de la Société de Chirurgie*, No. 32, 1915.)—Tuffier, for the purpose of localizing foreign bodies in the tissues, employs a new application of the Hughes induction balance. He has a simple pastille, the size of a 50-centime piece, attached by a tube of caoutchouc to the electrical apparatus constituting the Hughes balance. The pastille is placed at the extremity of the index finger under the surgeon's glove, and by the telephonic connection the finger vibrates when it approaches to within 1½ to 2 cm. of the foreign body. It makes little difference whether this foreign body is magnetic or not, although, if the non-magnetic body is of very small size, it may escape. The apparatus works with a current of 2 volts, and therefore a dry battery or accumulator may be used. It has also the advantage of being of small size, and, further, permits of a direct access to the foreign body. Its weakness is that its radius of action is so limited. At a distance beyond 2 cm. from the projectile, no effect is felt. After employing it in four cases, however, the author finds it useful when a foreign body, although shown on the radiograph, is not easily localized after making the incision.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

SOME EXAMPLES OF BONE INJURIES CAUSED BY BULLETS, SHELL FRAGMENTS, AND SHRAPNEL.

By J. D. Morgan, B.A. (Cantab), M.D., C.M. (McGill), Capt. C.A.M.C.,
Radiographer with No. 2 Canadian General Hospital, B.E.F., France.

Much has already been written on this subject, and numerous skiagrams published to illustrate the effects produced by bullets or fragments of shell coming into contact with the various parts of the bony skeleton. The apparently unlimited variety of such effects has induced me to publish this further series of cases. Short explanatory notes have been given with each skiagram, but no attempt has been made to discuss the cases from a surgical standpoint, for the following reasons :—(*a*) It would be outside the object of this paper, in which it is intended to deal with the cases from the radiographer's point of view only. (*b*) To discuss the surgical treatment of such cases, the paper would assume book length. (*c*) As cases such as these have never been allowed to remain in this hospital until convalescent (all being shipped to England as

soon as they are fit to travel) notes on the surgical treatment employed would lose a considerable part of their value, as end results could not be given.

CASE 1.

CASE 2.

CASE 1.—Pte. V. was hit by a bullet in the left shoulder. The wound of entrance was in the posterior axillary fold, the exit wound (large) at the point of the left shoulder. There was a comminuted fracture of the head and upper third of the left humerus. The bone was badly shattered.

CASE 2.—Pte. S. M. had a small wound at the back and inside of the left upper arm, and a large wound in the front of the left shoulder. The neck of the left humerus was badly shattered and there was considerable displacement of the fragments.

CASE 3.

CASE 4.

CASE 5.

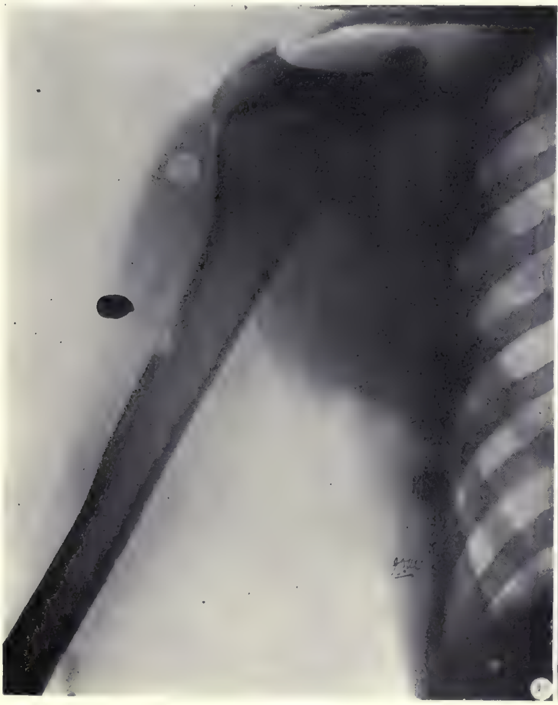
CASE 3.—L.-Corp. P. The wound of entrance was at the lower angle of the left scapula; that of exit in the axilla. Thence the bullet passed into the upper arm, causing a comminuted fracture of the shaft of the humerus. The bullet remained in the wound.

Case 4.—Pte. J. L. had a penetrating wound through the lower third of the right upper arm, and a compound fracture of the lower third of the right humerus, with much shattering and displacement of the fragments. The joint was not involved.

Case 6.

Case 5.—Pte. W. D. There was a small wound about the middle of the radial border of the left forearm and a second large wound over the end of the ulna. There was a comminuted fracture of lower third of the radius and of the lower end of the ulna.

With these, compare the following cases in which but little of the shattering effect is seen, the explanation being, no doubt, that the bullets had, at the moment of impact, a greater velocity in the latter, than in the former, cases.



Case 7.

Case 8.

Case 6.—Pte. L. had a penetrating wound an inch below the malleolus, right foot. The bullet passed straight through the os calcis, leaving a clean hole with no shattering effect. No doubt the internal structure of this bone partly accounts for this.

Case 7.—In this case the bullet remained in the wound, and is shown almost "end-on" in the skiagram. Comparatively slight damage was done to the shaft of the bone.

Case 8.—L.-Corp. P. The bullet perforated the lower third of the right forearm.

Case 9.—Pte. J. B. The entrance wound was on the outer side of the knee. There was a fracture of the lower third of the femur. The bullet remained embedded in the bone, with only its nose protruding at a point one inch above the internal condyle.

Case 10.—Perforating wound of the middle of the shaft of the tibia.

Case 11.—Pte. J. M. The wound of entrance was at the junction of the middle and lower thirds of the right lower leg.

Case 12.—Rfm. R. D. complained of a severe pain in the right knee. There was a bullet wound over the internal condyle of the tibia. The bullet lay embedded in the bone just below the external condyle.

Case 9.

Case 10.

One would naturally expect shell fragments to have a greater shattering effect than bullets, owing to their irregular shape, their (frequently) larger size, and the slower velocity with which they travel.

Case 13.—L.-Corp. H. was hit by fragments of a shell, resulting in a comminuted fracture of the lower end of the right femur, in which some large pieces of metal were lodged.

Case 14.—Here we have a similar condition, involving the lower end of the tibia. Gas gangrene having developed, amputation was performed above the knee joint.

Case 15.—Pte. S. was wounded just internal to the left patella. There was a comminuted fracture of the lower third of the left femur. The bone was badly shattered, and a large piece of metal remained in the wound. The condition of the limb was such that it was deemed advisable to amputate it. The patient's condition improved rapidly after the operation.

Case 16.—Pte. D. had a large shell wound in the lower third of the right leg. The skiagram shows an "explosive" effect. There was a perforating wound of the upper third of the right tibia, and a comminuted fracture of the lower end of the same bone with very bad

shattering effect. There was also a transverse fracture through the lower third of the right fibula.

Again, compare these with the following cases, where, in spite of the irregular shapes of the metal fragments, no shattering of the bones occurred.

Case 11.

Case 12.

Case 12a.

Case 13.

Case 14.

Case 17.—Pte. W. F. was injured in the lower part of his left leg. He was, however, able to hobble back to the dressing station. There was a penetrating wound three inches above the

malleolus. The skiagram shows a penetrating wound through the lower third of the fibula, and the piece of metal embedded in the tibia.

Case 18.—Sergt. H. D. was wounded by a piece of high-explosive shell at a point six inches above, and one inch in front of, the external malleolus of the left leg. A piece of leather legging was removed, but no metal found, at the first dressing. A skiagram, however, showed the presence of a large foreign body embedded in the lower third of the left tibia.

A fracture caused by a shrapnel ball frequently bears resemblance to one caused by a blow from some blunt instrument. This, of course, may be accounted for by the rounded shape of the bullet, by its great weight relative to its size, to its softer consistence (being, as a rule, of lead), and to its comparatively low velocity.

Case 19.—Sergt. W. W. was wounded by a shrapnel ball, which hit him about the middle of the external border of the right upper arm. There was a comminuted fracture of the middle

Case 15.

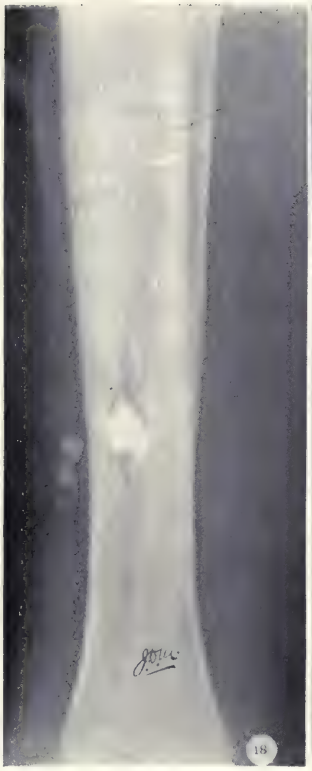
Case 16.

of the shaft of the right humerus. At the operation the brachial artery was found to have been seriously injured. It was therefore ligatured. The shrapnel ball and three bone fragments were removed, one of the latter being a large jagged piece some two inches in length.

Case 20.—Pte. M. was wounded about the middle of the anterior surface of the right leg. In the skiagram an incomplete spiral fracture is seen, the ball lying posterior to the external border of the neck of the tibia.

Case 21.—Gnr. A. The bullet wound was on the external surface of the lower third of the left leg, about four inches above the malleolus. There was an oblique fracture in the lower third of the shaft of the tibia. The shrapnel ball lay near the lower extremity of the fracture, at a point abo t one inch above the internal malleolus.

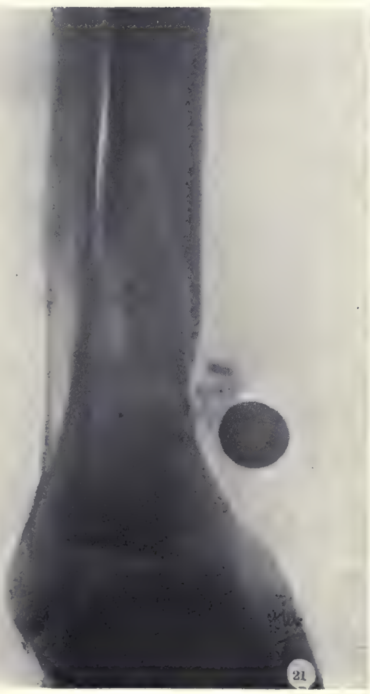
CASE 17.



CASE 18.

CASE 19.

CASE 20.



CASE 21.

CASE 22.

SOME EXAMPLES OF BONE INJURIES CAUSED BY BULLETS, SHELL FRAGMENTS AND SHRAPNEL.

BY CAPT. J. D. MORGAN.

PLATE 12.

Case 22.—Gnr. W. G. had a lacerated and dirty wound on the outer side of the right thigh, just above the knee joint. The knee was greatly swollen. There was a comminuted fracture in the lower third of the femur. The shrapnel ball lay just internal and posterior to the inner condyle.

I am indebted to the following gentlemen for these cases:—Lt.-Col. Rudolf, Major Mackenzie, Major Vesey, and to Captains Macleod, Menzies, Croll, Wilson, Bethune, Mackay, MacBeth, Burke, Chown, and Rogers.

APPENDICITIS: ITS RADIODIAGNOSIS.

By Geo. Vilvandré, M.R.C.S., L.R.C.P., Capt. R.A.M.C. (T.C.),
Radiologist, General Hospital, B.E.F.

One need perhaps apologise for mentioning the fact that appendicitis and fœcal concretions are frequently connected together. Of the following cases the first brought the matter home so forcibly, from a radiographic point of view, that I do not hesitate to think that appendicitis has not received, up to the present, its share of attention from the surgeon-radiographer.

The patient concerned was admitted to hospital under the care of Captain Pepper, whom I am quoting as follows: "The patient had severe abdominal pains, a temperature of 102. Pulse 112. On examination I found the abdomen very rigid and tender on pressure, particularly over McBurney's point. Some thickening was palpable over in right iliac fossa, and condition suggested abscess formation. . . ."

The patient was sent to another hospital, and there a provisional diagnosis made of paratyphoid fever. He was therefore transferred to the Infectious Division of the General Hospital (under the care of Captain McIntosh), whose notes mention that on the 12th of October his temperature was 103. Pulse 108. The abdomen was distended, tender, with some rigidity over the right iliac region, sweating, very much pain just below the umbilicus.

Enteric fever was excluded clinically and bacteriologically. Apparent enlargement of the gall bladder, with tenderness and rigidity was observed. The patient was then sent to be radiographed, with a suggestion of possible gall stones. From the site of the pain I was led to investigate the right iliac region, and the enclosed radiogram was the result (No. 1).

Operation was performed, the large fœcal concretion, as shown, was found. It consisted of hard, dried fœcal matter, which, on being broken up, showed some reticulated formation. The appendix was gangrenous, many adhesions present. The patient died several days after.

I have given the case at some length to show the uncertainty of the diagnosis, the signs and symptoms altering with the time, one concrete fact emerging—the concretion.

The difficulty of making a diagnosis between appendicitis and inflammation of the gall bladder and conditions dependent upon it is no new one, and here comes my point:—the possible help of a radiographic examination in such cases, because fœcal concretions are often common in appendicitis, being found in 15-20 per cent. of the cases, whilst foreign bodies are present in 4 per cent. Osler, quoting J. F. Mitchell, gives 45 per cent. fœcal concretions in 700 cases of foreign bodies found in the appendix. "And," says he, "the great importance of these concretions is shown by the great frequency with which they are found in all acute inflammations of the appendix."

It seems that in doubtful acute abdominal cases an X-ray examination may prove of great value. In this I exclude those cases where renal, ureteral, or vesical calculi are suspected, referring to gall stones later. There are many cases where the surgeon, even he of worthy repute, is at sea, where precious time is often wasted, because of the deficiency of clinical signs, to make up his mind—times even when laperotomy would be performed if a slight indication were given that the case was one for surgical interference.

Such is the type of case that should be radiographed, and to this class belongs the case I have just introduced.

Now, let us consider the interpretation of the radiogram and the differential diagnosis of appendicular fœcal concretion and other shadows likely to be observed.

Jaugeas briefly mentions calculi of vermiform appendix as a source of error in the diagnosis of ureteral calculi. He thus dismisses the subject.

In all probability such an error of interpretation will be possible only in the appendix lying in the 3 o'clock position over the psoas and hanging over the brim of the pelvis, if sufficiently long. Otherwise ureteral calculi are situated more internally.

As the appendix has not a fixed position, its situation being dependent upon its length and its mesentery, it follows that any fœcal concretion in it will be visible in any place in the iliac fossa. Cunningham gives its most usual position as that behind the cæcum.

The shadow of an impacted gall stone, or one in the lower end of the common bile duct, will appear at a higher level than an appendicular concretion, the common bile duct passing behind the duodenum and head of the pancreas, and ending by opening into the second part of the duodenum, which is to the right of the second lumbar vertebra. The shadow of such a gall stone will, therefore, be more internal than either an appendicular body or a ureteral calculus.

Further radiographic investigation of appendicitis met with success, I am glad to say. Thanks to the kindness of my friend, T. Twistington Higgins, I had the opportunity of radiographing case No. 2, which he had previously diagnosed as appendicitis in an acute stage. A distinct thick shadow is seen to the right of the transverse process of the last lumbar vertebra.

At the operation Captain Higgins found an appendix, thickened in its

Case 1.

Case 2.

Case 3.

Case 4.

APPENDICITIS: ITS RADIODIAGNOSIS.

By Capt. Geo. Vilvandré.

Plate 13.

upper part, gangrenous in its lower, and on the point of perforation. The section revealed some thick pus. The whole organ was greatly congested and dark in colour. The shape and position corresponded to the shadow on the radiogram.

No added risk is entailed by such procedure, especially in hospital practice, where the patient is radiographed just before operation, and is carried from the X-ray room to the theatre. Far more damage is likely to follow repeated palpation of the iliac fossa, where there may be a sac of pus under tension.

This patient made an excellent recovery.

The third case in order, though X-rayed before the above, shows a shadow of a probable concretion, which could not be verified, as the patient was not operated upon. He had been diagnosed as suffering from repeated attacks of appendicitis, but he declined operation, and was sent to England, his case not being acute.

It is not without significance that the next case, No. 4, was sent to me for investigation as one likely to have a gall stone. A definite shadow is seen above the iliac crest. No operation was performed and no verification possible.

The appendix has, of course, been investigated by means of bismuth and barium by several radiologists, and excellent radiograms have been the result. Dr. Robert Knox, in his excellent book on "Radiography and X-ray Therapeutics," mentions also that "pus, the result of an inflammatory process, may occasionally be seen," but I am persuaded that much benefit will be derived by an X-ray examination of acute cases, without white meal, of course, where careful technique will reveal many conditions unsuspected, or make the diagnosis certain in other cases. It is a short step from the actual radiogram of an acute thickened appendix, or one containing a concretion, to a stereoscopic presentation of the same. An acute appendix is not likely to alter in position, and such stereoscopic view may prove of help to the surgeon. In any case it will certainly tend to shorten the operation, as much precious time is often taken up by hunting for the diseased organ among the coils of bowel. To know before operating that the offender is hiding behind the cæcum or over the brim of the pelvis must prove a distinct advantage to both surgeon and patient. The process is, after all, but the localizing of a foreign body.

The technique should be easier in children, its value probably greater than in adults.

It had been my hope to investigate a great number of these cases, but a large and busy war hospital does not lend itself easily to such work.

If my remarks be of any value I humbly hope someone at home will use his greater skill and better opportunities in the radiographic examination of an acute disease which claims so many thousands of victims in England per annum.

My thanks are again due to the Surgical Staff, especially to my friend

T. Twistington Higgins, and to my assistant, Pte. Edgar Taylor, for his keen interest in the work of the past year.

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THE REACTION OF DEGENERATION IN MEDICAL LITERATURE.

By NOEL H. M. BURKE, M.R.C.S., L.R.C.P.,

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WHILE looking up a point with reference to peripheral nerve injuries in several works on surgery, I found, incidentally, that each one gave a different exposition of the reaction of degeneration. It seemed obvious, therefore, that the hour was ripe for calling attention to the lack of uniformity in the teaching given to the profession in this respect, as displayed by the varied utterances of those who write our classical text books and works of reference.

Several hours spent in the library of the Royal Society of Medicine produced quite interesting revelations. Eight works on surgery, seven on medicine, four on neurology, and four on electrotherapeutics were examined, primarily with respect to this question of the definition of reaction of degeneration. A glance was given, in passing, to the various suggestions as to treatment by electrical methods. The result of this investigation leads to the suggestion that the authors of many of these books on more generalised medical and surgical subjects, have either written their few electrical statements from memory of their student days, or have copied them without question from standard works by others who have themselves done so. In this manner mistakes have been perpetuated and given authority. It is a little curious that this should be so—even in England, where the electrical branch of medicine is little understood—for the same authors, as a rule, engage the assistance of a specialist in the production of their chapters on other specialised subjects, such as pathology, anæsthetics, or the nose and throat.

Of course, no names are given here, as the object of this article is solely to plead a necessary reform on principle ; but it may be said that the books which were investigated were all modern, and in their latest editions, the oldest being dated 1907, while two were 1908. They include the text books most commonly used by students in preparing for examination, and the larger and first rank books of reference. The former will supply the basis of

knowledge for perhaps the mass of the profession, the latter for the more enthusiastic seekers after information.

The analysis of the statements found is as follows :—

Five give the essentials of the reaction of degeneration as consisting of :

Response to Faradic stimulus absent, to Galvanic slow and sluggish, and to anodal closing greater than to kathodal closing.

Others give the same three points with qualifications :

One stating that the polar change is the important point,

Four, that it is usual but not so essential as the other factors,

One, that the sluggish contraction is "extremely typical" of reaction of degeneration.

Of three who say that the Galvanic response is slow, with A.C.C. *equal to or greater than* K.C.C., one declares the Faradic response to be *absent*, while the others say that it is *decreased or absent.*

Two give the absent Faradic response and the polar change, and make no mention of the sluggish nature of the contraction.

Three describe no Faradic and a slow Galvanic response as the real essentials, stating that the reversal of polar phenomena is common, but quite unreliable and unessential. These will be referred to at length below.

One author gives the absent Faradic response, and speaks of "increased sensibility" to the Galvanic current, with the polar change.

The most extraordinary definition is to be found in what—if size and price be any standard—is one of the best of all the books in this series, and is dated 1912. Here occurs the definition of reaction of degeneration as consisting of :

Loss of excitability to Faradism, with increase of "contractility" to Galvanism.

The exact meaning of this seems obscure.

Two more books are left, of which one describes the polar reversal as being the only point in reaction of degeneration, and makes no reference to the two other factors, while the last talks round the subject, but never gives a definition.

Here we have several versions of an important fact in medicine divided into three or four main contentions, and with a good deal of contradiction, the one of the other.

It would seem that some of the authors have no clear idea of the matter themselves, or have no concise and simple form of words in which to impart their knowledge to others.

What are the facts as laid down by those with most experience of the examination of diseased or injured peripheral nerves ?

Professor Erb, of Leipzig, in 1868, first used the term "reaction of degeneration," and described the syndrome as consisting of : Absence of response to Faradic stimulation, slowness and sluggishness of Galvanic response, together with the reversal of the normal order of contractions, so

that the anodal closing contraction became greater than the kathodal closing contraction.

He referred to this polar change as being "one of the most constant phenomena in medicine."

For many years those who have followed, and have used any care and precision in stating their views, have given his formula, and have accepted it without question; but in more recent times a realisation has grown up that the third postulate is inaccurate.

Time has not allowed me to deal with the foreign literature, but it would seem that here and in America the latest view, and that most worthy of acceptance, is that of Sherren, Lewis Jones, Cumberbatch, and others who are now seeing the very large number of cases provided by the war.

The late Dr. Lewis Jones, in his *Medical Electricity*, said :—

"This alteration of the relative effects of the poles is not an essential part of the reaction of degeneration, for it is not constantly present, although it was formerly thought to be a concomitant of the reaction" ; and again : "In the opinion of many workers, the phenomenon is so inconstant a part of the reaction of degeneration as to be without diagnostic value."

In *Injuries of Nerves and their Treatment*, 1908, Sherren states that "this change, though usual, is probably not invariable" ; while in the very latest work on the subject—Cumberbatch's edition of Morton's *Essentials of Medical Electricity*, 1916—it will be found that "this polar reversal, as it is sometimes called, is no longer included as essential for the diagnosis of reaction of degeneration."

Of the twenty-three books in this series, seven give a correct account of reaction of degeneration.

Of the rest, five are substantially accurate, but give the polar change undue prominence as an essential constituent of the reaction.

The fact is, that those who are called upon to examine and report on the reactions of these injured peripheral nerves, have long given up any investigation of the polar responses. It is true that the polar change is very frequently seen, but it is found, as quoted above, that instead of being a reliably constant phenomenon, it is subject to much variation, not only among different cases, but also from moment to moment during a single examination of any individual patient. I have frequently watched the testing of cases in the Electrical Department of St. Bartholomew's Hospital, when the polarity tests have been made as a demonstration. Any one selected muscle would then be found to give a better contraction for stimulation, first by one pole and then by the other, and with very little apparent reason for the change.

It is probable that the polar response depends on all those variable factors in "muscle testing" which have led to a search for a more uniform and constant means of ascertaining the condition of a suspected nerve—that is to say, the temperature of the part, the condition of the skin, position and size of electrodes, degree of pressure exercised by the testing electrode, and so on.

Mention of these difficulties leads to a matter, the consideration of which is not out of place in this article. Should the term "R.D." be used at all? should the Faradic and Galvanic currents be used for testing? and how much is it all really worth when translated into a diagnosis?

To meet these difficulties two main suggestions have been made.

One is the use of the mechanically interrupted current of Leduc's apparatus, whereby the duration, frequency and amount of impulses can be accurately controlled.

The other and simpler is the method of testing by condenser discharges, as suggested by Boudet in 1888, and developed by Cluzet, Doumer, Lewis Jones, and others.

The advantage claimed for these methods is that of measurement. The stimulus is made in a form which is capable of accurate standardisation and measurement, and can be easily repeated without variation on a subsequent occasion. A definite numerical figure can thus be put down to represent the value of the neuro-muscular condition on a given date, and a real comparison made of case with case, and in individual cases from time to time during the progress of treatment.

The hope of Lewis Jones was that muscle testing would be so simplified that a neuro-muscular mechanism which responded to a condenser of a certain capacity or less, could be written down as normal, while that which required a capacity above a certain figure would be abnormal. There are some enthusiastic observers who believe that this method is as good as its inventors hoped it would prove, and who have entirely discarded the older tests, and therefore the use of the phrase "R.D."

Others with equal experience, and just as much good will to believe in the condenser system, have been unable as yet to repose their entire confidence in it alone, and still rely at least as much on the old method as on the new for the purpose of diagnosis.

Those who have sufficient patience, and have, or can make, sufficient time, carry out a careful examination of all cases by both methods. It is probable, therefore, that the term "R.D.," with its subdivision of complete and partial, will persist for a few more years at least, and that a proper definition of it will be an essential in every authoritative publication which bears on the subject.

REPORTS OF SOCIETIES.

JOINT MEETING OF THE CHICAGO MEDICAL AND CHICAGO ROENTGEN SOCIETIES, March 22nd, 1916.

Chairman: JAMES T. CASE, M.D., F.A.C.S.

Pulmonary Abscess and its Roentgen Demonstration.

P. M. HICKEY, Detroit, Michigan, read a paper on this subject. He considered the principles upon which the Roentgen diagnosis of suppurative processes depends. The Roentgenogram gives a record of density of the parts examined. Fluids of necessity cast a very distinct shadow, on account of the water which they contain. Fluid water distributed in small amounts in the larger bronchi or encapsulated within abscess walls usually shows to good advantage, inasmuch as there is a surrounding background of the air-filled sacs.

The author showed a slide from a plate of a five-year-old boy who was suspected of having empyema, but as the needling of the chest failed to reveal any fluid he was subjected to an X-ray examination. The slide showed a large nail in the right bronchus, with the marked pulmonary changes. A careful reservation of the case, with the obtaining of an accurate history, shows that the foreign body had been present for about four months. The irregular light and dark areas in the right pulmonary region afforded a typical Roentgenogram of gangrene of the lung. Here was a type of infection accompanied by small localized areas of necrosis with the production of small amounts of pus. At the removal of the foreign body the most painstaking efforts were immediately made to aspirate the fluids from the bronchi, yet the patient nearly drowned in his own secretion and died from an infection of the other lung. In this case he felt that if the removal of the foreign body had taken place earlier in the clinical history, while the patient's vitality was as yet unaffected by a prolonged suppuration, the result would have been more favourable.

Another slide showed a different type of infiltration of the lung, produced by a brass screw in the right bronchi, where it had been present for six weeks. During this time the patient had passed through what was called a broncho-pneumonia. At the time of the attempted removal the bronchi were so filled with muco-purulent exudate that the screw was not found. Some months afterwards it was learned that the patient, besides an occasional slight cough, showed no symptoms of the foreign body. Here the Roentgenogram showed the typical filling of the branches of the bronchial tree going to the various lobes of the lung, with the extension of the exudate into the smaller bronchi. The contaminating organism here evidently was not productive of local necrosis.

In another case the slide showed free fluid in the pleural cavity, uncomplicated by pneumothorax. Attention was called to a comparison of the phreno-costal angle on the affected side with the phreno-costal angle on the normal side. Where we have a Roentgenogram of pleurisy with effusion, there is noted a complete disappearance of the phreno-costal angle, a Roentgen sign which is almost invariable, because in no other way than through free fluid present in the pleural cavity do we get the radiographic obliteration of the phreno-costal angle. The little triangular piece of lung tissue which fits in that angle rarely has a complete filling of its air cells by any pathology of intrapulmonary origin.

If free fluid is present in the pleural cavity, complicated by a pneumo-thorax, we get a straight line which is indicative of the fluid level. Free fluid, water in the pleural cavity, or within an abscess cavity, is the only condition which produces a straight line in the Roentgenograms of the chest. In addition to this straight line, the ordinary appearances of a pneumo-thorax are noted, such as increased radiability on the affected side, evidenced by the lack of tissue detail between the ribs and the sharper accentuation of the cancellous structure of the rib.

In summarizing, the essayist drew attention to the following prominent points:—

1. He emphasized the conclusions recently published by Manges in his series of cases of lung abscess after tonsillectomy; that tonsil-

lectomy in the adult is an important operation and requires a good operative technique to minimize the tendency to aspiration infection.

2. It is important in making the Roentgen examination of a pulmonary case to use the different positions for Roentgenoscoping the patient, and also to make use of the stereoscope.

3. That the recognition of the rôle of the Roentgenologist as a consultant is always productive of the best results.

The author felt, in conclusion, that in the future the use of the Roentgen ray in the investigation of chest cases will displace to a great degree the use of the stethoscope. He would say this only after mature consideration, and with a full knowledge of the importance of the problems involved. The inadequacy of the stethoscope as a sole agent in the elucidation of difficult problems of chest diagnosis is beginning to be well recognized.

Discussion.

Frederick Tice said the profession was relying more and more upon fluoroscopic and skiagraphic examinations. He thought that most good could be obtained by co-operation or team-work.

Personally, one of the greatest difficulties he has encountered has been the interpretation of the plate, as a general rule, and chiefly, perhaps, for the reason that many of the plates are taken by the X-ray operator who has had only a limited amount of clinical experience, and who has, perhaps, not examined the patient at all. He simply makes the plate and gives his interpretation of the findings. A careful clinical history and a report of the physical signs should accompany the presentation of the patient, and after plates have been taken a conference should be had between the X-ray laboratory man and the clinician.

Only within the last few months a patient suffered from a lobar pneumonia; the crisis was irregular; the temperature continued, and it seemed, to a number of competent men who examined the patient, that a pulmonary abscess was present. On several occasions the side was needled in front and behind, but no pus was found. The patient was X-rayed on two occasions with a negative report. Within the course of three or four days, after patient had returned home from the hospital, in a paroxysm of coughing one night there was a spontaneous rupture, and patient expectorated more than a pint of pus. With team-work between the clinician and laboratory man a more accurate interpretation and better results might be attained.

Charles L. Mix acknowledged that the internist does not find it easy to make a diagnosis of a cavity in the chest at all times. In order to find a cavity in the chest it must be of rather large size and near the chest wall. The best physical signs are obtained by auscultation. By percussion the practitioner is able to demonstrate the presence of a cavity in a very small proportion of cases by following Gehrhart's method of percussing the body in both the upright and prone positions; but it is safe to say it is difficult in one cavity out of a hundred to demonstrate a change in the fluid level by percussion. We are better able in these cases by the percussion method, open and closed (Winternitz method), to determine the presence of a cavity. The practitioner can determine the presence of a cavity sometimes by finding a hyperresonant note in the changed position with one which is rather dull; but these things leave us in the lurch, and practically the only safe guide is in finding amphoric breathing where it should not be, or finding large bubbling râles where they ought not to exist. When one contrasts the unsatisfactory physical findings with the demonstrations given by the essayist, it is quite evident the Roentgenogram is far more effective in giving evidence than a physical examination; nevertheless, a physical examination does lead to the detection of these cavities.

The speaker related the case of a nun who, about twelve days after an operation for the removal of the tonsils, was taken with a sharp fever and developed a purulent expectoration very much like the expectoration seen in a fetid bronchitis. This led to an abscess, which was demonstrated by the physical findings without an X-ray at first. Furthermore, it was demonstrated by needling, and patient was operated on by Dr. Murphy. She weighed 83 pounds at the time of operation, which was performed a little over a year ago, but now weighs 109 pounds, according to the latest report, and bids fair to make an ultimate

recovery. The case was first diagnosed as tuberculosis, as many of these cases are, and subsequently found to be a pulmonary abscess.

Robert H. Babcock was loath to admit the postulate that clinical examination by means of the stethoscope and percussion is to be replaced by X-ray examination. X-ray examinations of the chest are of the very greatest importance. For over thirty years he has depended upon other means of diagnosis, yet within the last two or three years he has come to depend very much upon the assistance of the Roentgenologist in the diagnosis of chest conditions. Perhaps the great value of X-ray examination of the chest in suspected cases of pulmonary abscess is to be found at the time before the abscess has evacuated itself. Most clinicians can demonstrate—at least in a tentative manner, if not conclusively—the presence of a cavity, but no man can always determine that the area of consolidation in a lung is one simply of pneumonia—a consolidation which has not terminated in abscess, has not broken down into pus, or is one of abscess formation which has not evacuated itself, and it seems to him there is the chief value in calling the Roentgenologist to the aid of the internist; also in the differential diagnosis in some of the cases the internist is called upon to determine whether the pus which the patient is expectorating is from an abscess cavity in the lung, or is from an empyema that has ruptured through into a bronchial tube. He has such a case under observation at present, and is depending upon the Roentgenologist to help him out.

James B. Herrick asked Dr. Hickey what would probably be the appearance of the X-ray in those cases of pulmonary abscess that did not contain air, so that there is no change in the level of the fluid.

Dr. Hickey, in replying to Dr. Herrick, said that in a patient of average size any cavity which can be demonstrated at autopsy can be shown by stereoscopic Roentgen plates under a proper technique.

Spasm of the Stomach and Duodenum from a Roentgenologic Viewpoint.

Russell D. Carman, Rochester, Minnesota, stated the favourite playground of spasm, whether of intrinsic or extrinsic origin, is the stomach. Spasm of the stomach, arising from an intrinsic lesion, is generally produced by ulcer, less often by cancer.

Three forms of spasm due to gastric ulcer may be distinguished: (1) the incisura or hour-glass stomach; (2) diffuse spastic distortion, and (3) spasm of the pyloric sphincter.

1. The incisura is a spastic contraction of the circular muscle fibres in the plane of the ulcer, and shows as an indentation of the opposite curvature. Usually narrow, but of variable depth, persistent and permanent as to situation, it suggests at once the nature of the lesion, and points towards its site. The cavity of the ulcer itself may often be seen as a niche or pocket, but sometimes neither can be distinguished. In the latter event, the incisura, either alone or in combination with other functional disturbances, may be a guide to the diagnosis which otherwise could not be made.

When the incisura is deep, the stomach is bilocular, and the examiner may either describe it as an hour-glass stomach, or emphasize only the incisura. In other instances, the width and depth of the constriction are so extreme that the characteristics of a typical incisura are lost, and a pronounced hour-glass form is seen.

2. Gastric ulcer often gives rise to a diffuse spasm affecting a considerable extent of the pyloric segment, whether the ulcer be situated in this region or higher up in the stomach. The stomach, well outlined in its upper portion, shades off into a poorly filled, vaguely outlined, antral area, which may resemble the filling defect of a pyloric cancer.

3. An ulcer situated in the pyloric segment is frequently accompanied by a retention from the six-hour meal. Ulcers situated well away from the pylorus are occasionally associated with a six-hour retention. This retention has been variously ascribed to reflex pylorspasm, to impairment of peristalsis by the ulcer, to gastric hypotonus, and to pyloric spasticity excited by hyeracidity. Be this as it may, we have seen cases of gastric ulcer in which a retention from the six-hour meal was the only discoverable sign. This, taken alone, was, of course, insufficient for diagnosis.

Cancer of the stomach, aside from the organic filling defect produced by the tumour mass, may also produce more or less spastic

distortion of the gastric contour. For example, a cancer involving only a portion of the lesser curvature may be accompanied by a spastic indrawing of the greater curvature opposite the lesion. When present, it is usually of considerable width, and exaggerates the lumenal narrowing produced by the tumour.

Duodenal ulcer is occasionally associated with a gastric incisura, or an hour-glass stomach. Equally misleading is a spastic filling defect, of extrinsic origin, occurring more commonly in the pyloric end of the stomach, and resembling a pyloric cancer, or the diffuse spasm provoked by a gastric ulcer.

In many instances, after giving a barium meal, none of it is seen to pass the pylorus for several minutes. At operation a cholecystitis or a chronic appendicitis is found, but no lesion of the stomach. In such a case there is evidently a pylorospasm, not necessarily in the clinical sense, but a spasticity of the pyloric sphincter, for which the only explanation that can be offered is the diseased gall-bladder or appendix. Sometimes the entire pyloric third of the stomach is shrunken to a stiff narrow tube, which may be palpable to the examining fingers. The tube projects like a spigot from the well expanded fundus, and shows a striking likeness to the canal through a pyloric tumour. In this species of spasm disease of the gall-bladder is frequently found.

1. Deformity of the gastric outline produced by an organic lesion is persistent, constant in situation, and unvarying in aspect. If due to a new growth and accessible to manipulation, it will sometimes correspond to a palpable mass. Its borders are sometimes sharp, but more often gradually shaded off. The niche and accessory pocket of gastric ulcer are pathognomonic of themselves. Adhesions about the stomach, other than those from ulcer and gall-bladder disease, are relatively rare. If the gastric lumen near the pylorus is markedly encroached on by an organic process, some degree of obstruction will be shown by a six-hour retention.

2. Spasm resulting directly from an ulcer or cancer in the stomach is manifest usually in the segment involved, and especially in the area opposite the lesion. It is constant in situation. It is persistent and unvarying, although it has been claimed that shallow erosions may cause intermittent spasm. If the spasm takes the form of an incisura or hour-glass, its borders are clear cut, but if a large area is involved, it may show as an indefinite zone of incomplete filling. The lesion provoking the spasm may be seen as a niche, accessory pocket, or a neoplastic filling defect. The progress of the meal may or may not be retarded, depending on the extent and situation of the lesion rather than on the spasm.

In the duodenum a probable form of intrinsic spasm which has not heretofore been emphasized is that accompanying duodenal ulcer. Deformity of the bulb has been generally attributed to the ulcer or its scar, producing an organic filling defect. This is doubtless true in many instances, but the following phenomena deserve consideration:

1. In those cases in which organic distortion is present, the deformity noted at the Roentgen examination often far exceeds the deformity found at operation.

2. Cases are seen occasionally in which the ulcer or its scar, as found at operation, is small and quite insufficient of itself to produce a recognizable filling defect in the Roentgenogram. This fact made him very sceptical for some time of the validity of Cole's sign. However, these cases do frequently show pronounced irregularity of the bulbar shadow, and this must be due to some cause other than the organic alteration of the bulbar wall.

3. In the above described type, on plates made in the dorso-ventral position, the disfigurement is seen on the lateral borders of the bulb, although the ulcer is usually situated on the anterior wall.

4. The bulbar distortion often displays other characteristics of spasm. It is clean-cut in the outline, projects deeply into the bulbar lumen, and is wholly comparable to the incisura of a gastric ulcer.

5. That duodenal ulcer, like other ulcers, is an efficient spasm-producing agent, is indicated by its association with spasm in the stomach and elsewhere.

From these facts it seems reasonable to conclude that intrinsic spasm plays an important part in the Roentgenologic evidence of duodenal ulcers, and that in the absence of

spasm no deformity of the bulb could be seen in many instances, and the case passed as negative.

Discussion

Prof. Arthur J. Carlson, University of Chicago, in referring to spasms of local origin, said that we cannot exclude central reflexes, even in the case of local lesions in the stomach or duodenum; but obviously the local contraction mechanism is involved. The great difficulty to the clinician and Roentgenologist is that spasms of the second group, the so-called reflex or non-organic spasms, apparently can duplicate in every detail those of the local organic type. This involves one of the most obscure points in the physiology of the alimentary tract, and physiology of the central nervous system. It is known that the tonus of the stomach and of the greater part of the small intestine depends upon the motor fibres of the vagus, but nothing is practically known as to the mechanism, chemical or nervous, that controls the vagus tonus. One can demonstrate that stimulation of the sensory nerves in the kidneys, the duodenum or the gall-bladder, normal or hyper-excitable, owing to infection or pathologic conditions, can increase the reflex of the medulla and vagus centres—the tonus mechanism. It may, after all, be entirely a chemical affair, that is, a change in the condition of the blood working on the medullary centres. So far as he knows, the added tonus mechanisms are practically decreased during sleep, that is, vasomotor tonus, tonus of skeletal muscles, tonus of all the neuro-muscular apparatus; but the vagus tonus of the alimentary tract, on the other hand, is increased.

Joseph G. Friedman said, so far as he is able to determine, the incisuras cause no symptoms, consequently they remain undiagnosed. The spasms which do cause symptoms are, he believes, those which more or less completely close off the stomach; that is to say, those which are part pyloric or pyloric, raise the tension of the stomach to such an extent that they cause an increased tension of the stomach contents and consequently give a feeling of discomfort. This type is the cause of the symptoms in the so-called reflex spasms. The stomach pain complained of is generally a late pain. Why it comes at that time he does not know, but he thinks that this spasm, like the pain in an ulcer, is generally a late pain. Personally, he doubts very much if the spasms are produced reflexly from distant causes anywhere near as often as they are diagnosed. In the gastro-intestinal literature one sees reference made to the diagnosis of spasm due to chronic appendicitis. Just why a chronic appendix should cause spasm in the stomach more than a chronic colitis, or more than a beginning carcinoma of the cæcum, he does not know. Certainly, chronic colitis or carcinoma of the cæcum is not given as a cause of spasm of the stomach, yet chronic appendicitis is given as a cause of spasm of the stomach very frequently. The only reason for this is that chronic appendicitis, so-called, is a disease which is found present in at least 75 per cent. of all individuals post-mortem, and which can be easily demonstrated at any operation, and when no other cause for the spasm can be found the appendix is removed and it is given as the cause.

The class of cases which yield to the belladonna test are neuroses and superficial ulcer. The most important clinical diagnosis one has to make is between neuroses and slight ulcer. Deep or chronic ulcer, one of long standing, is easy to diagnose clinically from an X-ray standpoint, but a superficial ulcer is difficult, and that is the weakest point, he thinks, in the X-ray diagnosis of ulcer.

Bernard Fantus pointed out that only a short time ago physicians were taught that pain in hyperchlorhydria was due to the excessive acid present. Since then it has been shown by Hertz and others that the stomach and even gastric ulcer are quite insensitive to concentrations of hydrochloric acid far beyond those we find in hyperchlorhydria, and it has been suggested that gastric pain is a pain due to spasm. From every possible standpoint, diagnostic as well as therapeutic, it is important to determine whether in all cases true gastric pain is from a lesion of the spine or is produced possibly outside the stomach from an adhesion, and whether such a pain is always due to a spasm. If this were established, he believes our therapeutics would be more rational and perhaps more

readily applied. It seems very easy to explain the reason why so many gastric pains are relieved by taking a drink of milk or a drink of water. When it is assumed that the pain is due to excessive concentration of hydrochloric acid, if one takes a drink it dilutes it. The question is, if it is not chemical irritation that produces pain, why is the pain relieved?

If there is spasmodic retention in the stomach, papaverin will remove or greatly lessen the delayed evacuation, so that in papaverin one has another drug alongside atropin which may be of great importance in the Roentgenologic examination of such cases.

Dr. Carman, in closing, said that what they try to establish at the Mayo clinic is whether the spasm is due to some cause outside or whether it is ascribable to a local condition in the stomach. That is the important thing that both the clinician and surgeon want to know. So far as he knows, we are not able to recognize gall-bladder disease, chronic appendicitis, or anything else outside the stomach by spasm in the stomach.

Some X-Ray Observations in the Diagnosis of Certain Chest Lesions; A Diagnostic X-Ray Sign in Erb's Paralysis.

Sidney Lange, of Cincinnati, Ohio, demonstrated by means of slides four cases of secondary sarcoma of the lung which have come under his observation recently, and which he has been able to check up by autopsy.

Sarcoma and carcinoma of the lung are not common. Primary carcinoma of the lung is very rare, and confined to those tumours which arise in the bronchial tubes, and more especially the larger tubes. Primary carcinoma of the lung arises in the neighbourhood of the hilus; in the same way, primary sarcoma of the lung also arises from the structure of the hilum in the vicinity of the mediastinum.

As to the frequency of tumours of the lung, the best statistics are those of the Munich Pathologic Institute. In 10,000 autopsies, 1,000 cases of malignancy of all kinds were found. Of these 1,000 cases, 184 were found to occur in the lung. Of these 184 cases, 83 per cent. were secondary, and only 17 per cent. primary.

The author believes that metastasis in the lungs from sarcoma in any other part of the body is common, and to be able to outline with the X-ray the characteristics of secondary sarcoma is of paramount importance, from both a prognostic and surgical standpoint.

Dr. Lange, by means of slides, showed the characteristic Roentgen signs of secondary sarcoma and secondary carcinoma of the lungs, as proved subsequently by autopsy.

Regarding the diagnostic X-ray sign of Erb's paralysis, he called attention to certain X-ray changes which occur in the humerus of children who have suffered from so-called Erb's paralysis, or birth palsy. Birth palsy occurs once in every 2,000 births. The cause of it is not definitely known, but two theories have been advanced. One theory is that the brachial plexus has been injured during delivery by forceps, or by traction of the arm; that is, certain fibres of the brachial plexus are injured which interfere with motion of the shoulder joint, so that the fifth and sixth cervicals are affected.

X-ray examination in these cases shows a discrepancy in the appearance of the head of the humerus on one side compared with the head of the humerus on the other. The head of the humerus is smaller on the affected side, not quite so broad. The epiphysis near the head at the greater tuberosity is not well developed as compared with the opposite side. The glenoid fossa is not so well developed. There is also a lack of development of the acromial process.

Discussion.

Milton J. Portis said that all cases of malignancy, primary and secondary, before they are subjected to any type of operation, particularly surgical, should have an X-ray examination of the chest, and especially a stereoscopic plate.

The slides shown by Dr. Lange were very conclusive. He had not felt until this evening that the differential diagnosis of secondary metastasis of the lung with carcinoma and sarcoma could be so clearly made, yet the slides on this point were definite and conclusive.

A great many of the cases of Basedow's disease seen to-day, mixed and obscure, which have not been benefited by the removal of one-half or two-thirds of the lobes, are cases, in his judgment, complicated by thymus

enlargement, thymus persistence, or thymus overgrowth. In these cases we could get a clinical clue by the presence of lymphocytosis if we would look for it. If we do not get it in one examination we will get it in subsequent examinations, and a careful X-ray plate would bring out the thymus if it is there.

A. W. Crane, of Kalamazoo, Michigan, referred to the prediction of Richard Cabot, that medical practice of the future will be carried on in hospitals where X-ray appliances can be utilized, and where all the resources of modern medicine can be brought to bear upon the case. This, he said, is a problem which it would be well for the general practitioner to consider, and it is being largely brought about by X-ray work and other means of instrumental diagnosis.

RÖNTGEN SOCIETY

At the meeting of the Röntgen Society on April 4th, the following resolution was carried unanimously, on the motion of Dr. W. Harwood Nutt, seconded by Dr. Sidney Russ:—

"We, the Council and members of the Röntgen Society, view with some concern the present conditions of the X-ray examination of patients in His Majesty's naval and military hospitals, in view of the fact that a number of installations, some of which we believe are defective in their means of protection, are in the hands of inexperienced X-ray workers, who do not fully realise the attendant danger. We, as a Society, would suggest to the responsible authorities that every installation, both at home and abroad, should be inspected by experienced radiologists, in order that efficient means be taken to ensure complete protection to patients and operators."

Mr. P. J. Neate demonstrated a chronograph he had constructed to work with the electroscope. He said that in a conversation which he had had with Captain C. E. S. Phillips, the latter commented upon the absence from trade catalogues of any form of chronograph which was suitable for measuring comparatively short and comparatively long intervals of time, and said that such an instrument would be useful for measuring the duration of electroscope readings. By means of a few oddments, he had arrived at what he ventured to think was a serviceable instrument. The prime mover was a rotating gramophone cylinder, so constructed as to make one revolution in ten seconds. By means of two pairs of opposing magnets, and a current alternating in its direction, communicated through a seconds pendulum, the synchronous oscillation of armatures, first to one magnet and then to the other, was brought about, and these, being connected with an aluminium frame having at the end of it a pen, a line of jerks corresponding to seconds was duly recorded.

Mr. B. H. Morphy and Mr. S. R. Mullard read a paper on the enclosed tungsten arc as a source of ultra-violet light for therapeutic purposes. They first showed some experiments with the open tungsten arc and Simpson arc, pointing out, that although these furnished a large amount of ultra-violet radiation, their use was open to grave objections in the hospital, owing to noise and sputtering and the need for continual attention. The enclosed arc lamp was the "Pointolite," recently evolved in the Ediswan laboratories for ordinary commercial purposes, and, for this special use, constructed in a quartz bulb. When raised to a certain degree of brilliancy the output of ultra-violet rays was considerable, and if the lamp was over-run, with consequent shortening of its life, the radiation extended much further into the ultra-violet region of the spectrum. He admitted that it was deficient as compared with the open arc in rays of very short wave-length, but, judging from a recent paper by Dr. Sequeira, these rays were not likely to be of much value therapeutically, owing to their inability to penetrate the skin.

In the course of discussion, Dr. Sidney Russ pointed out that the range of radiation was quite different in the open and closed arc respectively, and he did not agree with the suggestion made by the authors of the paper that the very short wave-lengths had no medical value; this was a matter yet to be decided. Dr. Cumberbatch also thought that Mr. Morphy had begged the question in saying that there was no value in the shorter wave-lengths. No definite statement could be made about shorter or longer wave-length, but it was possible that any therapeutic value attributed to the tungsten open arc was due to the large number of waves of shorter length obtainable. Major Wilson, of the Canadian

Medical Service, said that ultra-violet light was proving of considerable use for the treatment of wounds at the front, and the French were using it quite extensively. He had himself been making experiments to secure an ultra-violet light of much shorter wavelength than anything hitherto obtainable, by striking an arc in tungsten vapour. Mr. Morphy, in reply, said that while, of course, he could not presume to judge on therapeutic questions, he had in mind a remark of Dr. Sequeira to the effect that the rays of very short wave-length did not penetrate the skin.

The final paper of a very full evening was read by Mr. W. E. Schall, B.Sc., and related some measuring experiments in connection with the Coolidge tube. He concluded that it was possible to find a radiation so hard that it would pass right through substances, either the emulsion of a photographic plate or the tissues of a human body, producing a very small effect indeed. The explanation of certain phenomena which he had found in the Coolidge tube might be that the radiation from this tube was heterogeneous, and that the more current that was passed through it, the greater was the proportion of exceedingly hard radiation which was undetectable, approximating in nature to the gamma radiation of radium, and possibly passing through the emulsion of the photographic plate without much effect upon it.

Mr. G. W. C. Kaye thought that Mr. Schall's experiments showed the inadequacy of the customary methods of measuring X rays.

NEW INSTRUMENT.

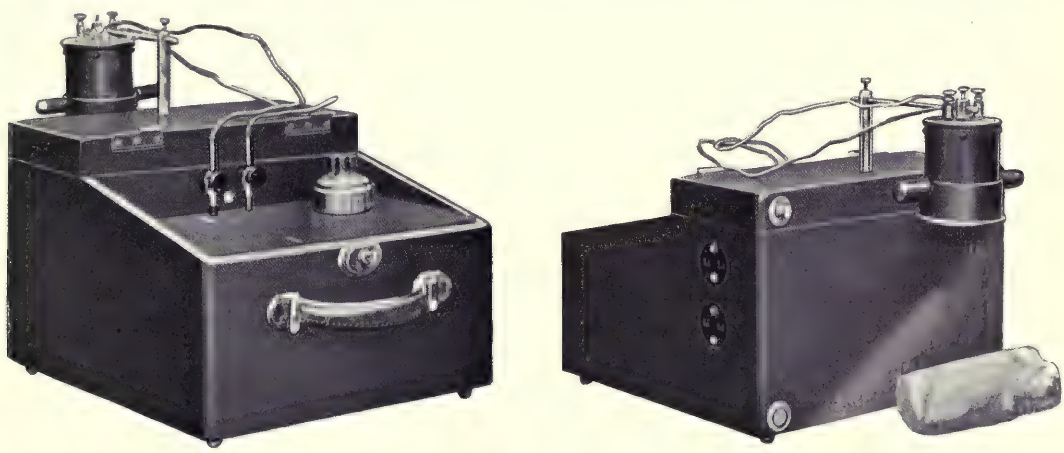
APPARATUS FOR PRODUCING ULTRA-VIOLET RADIATION.

By W. S. Andrews,

Reprinted from *General Electric Review*, April, 1916.

There is no distinct line dividing the visible spectrum from the invisible ultra-violet spectrum, as they melt one into the other like the various colours in the visible spectrum. The wave length of 4,000 Angström units may, however, be taken as the approximate wave length at which visibility ceases for the average eye, and at which the invisible ultra-violet spectrum may be said to begin.

The chemical power of ultra-violet radiation, as evidenced in the reduction of silver nitrate, etc., has been known for many years, but its wonderful property of exciting fluorescence and phosphorescence in certain mineral and organic compounds is not so commonly understood and recognized. Roughly speaking, the ultra-violet spectrum may be said to extend about two octaves beyond the visible spectrum, say from 4,000 A.u. to 1,000 A.u. When the invisible radiation somewhere



Front and Back Views of Ultra-Violet Radiation Generator.

within these limits of wave length falls upon a substance that possesses the property of fluorescence, the waves are absorbed by some atomic mechanism which we do not understand, and they are reflected or emitted again as light waves of greater length, thus dropping for the most part within the limits of the visible spectrum, so that the substance in question, although excited by a beam of *invisible* light, glows with one of the colours of the visible spectrum.

Different substances require different wave lengths to excite them to a maximum fluorescence, so it is, therefore, obviously desirable that the ultra-violet radiation used for producing fluorescence should include as much as possible of the invisible spectrum. In other words, if we could speak of it as visible light we might say that it should be polychromatic.

The high tension disruptive electric spark between iron terminals is very rich in ultra-violet radiation, covering about 80 per cent. of that part of the spectrum which is useful for producing fluorescent effects. A number of metals other than iron have been used for electrodes, such as zinc, cadmium, magnesium, nickel, cobalt, etc., but, while some of these produce more intense radiation than iron in certain regions of the ultra-violet spectrum, they fail to produce any rays of useful power in other regions, whereas iron shows a more uniform distribution throughout the entire range.

Iron electrodes have therefore been adopted for use in an outfit recently designed especially for the production of fluorescent effects, but these electrodes can be readily exchanged for others of a different metal that may be desired for some special purpose.

This outfit comprises:

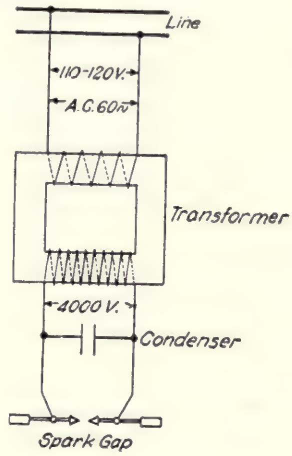
1. A small transformer that steps up 60-cycle, 110-120-volt alternating current to about 4,000 volts.

2. A suitable condenser.

3. An adjustable spark gap with removable iron terminals, the whole being protected in a chamber of insulating material.

4. Sundry fittings with connecting cords and plugs, etc.

All of the above parts are fitted into a neat mahogany box for convenient transportation, and it is only a few minutes' work to take out the spark gap, fit it in position and connect the apparatus to any suitable current outlet.



Connections of Apparatus

As this outfit only uses about 250 to 300 watts it can be safely connected to any alternating current lighting circuit.

The iron electrodes are enclosed in a small cylindrical chamber of insulating material, open at one end only, and having the insulated heads of adjusting screws projecting outside, by which the operator is able to regulate the frequency of the spark from 120 per second (with 60-cycle current) up to ten or twenty times that value.

This small outfit produces an abundance of ultra-violet radiation with which a number of very interesting fluorescent effects may be produced.

The following is a list of a few fluorescent substances, most of which are readily obtainable, and which appear white or nearly so under visible light, but which assume bright colours under the invisible ultra-violet rays:

Natural calcite from Franklin Forge, N. J., and other localities	Red
Barium sulphide, all tints of	Orange
Cadmium compounds	Yellow
Willemite, natural and artificial	Green
All salts of salicylic acid, such as soda salicylate, etc.	Blue
Some compounds of calcium	Violet

Many other compounds that show beautiful fluorescent colours might be mentioned, but the above suffice to include all the principal colours.

It is a remarkable fact that, broadly

speaking, many substances that are quite transparent to visible light are entirely opaque to ultra-violet radiation, while other substances are equally transparent to both. Thus glass, mica, gelatine, and celluloid even in very thin sheets are quite opaque to ultra-violet rays, but clear rock-crystal or quartz, fluorite and selenite are all about equally transparent to visible light and invisible ultra-violet rays.

These curious properties may be readily demonstrated thus:

If the light from the iron spark is directed on a lump of willemite, for example, the latter will glow with a beautiful green fluorescence. If a thin plate of glass or clear mica is now placed between the iron spark and the willemite, the green fluorescence of the latter will instantly vanish, and it will appear in its natural colour as seen by daylight or any ordinary artificial light. If now a plate of clear quartz or selenite is substituted for the glass or mica, the willemite will continue to glow with its characteristic green flourescence. It is thus made evident that the glass and mica are opaque to the ultra-violet rays which produce flourescence, while the quartz and selenite are transparent to them. This experiment may be tried with any fluorescent substance other than willemite with similar results.

Lenses made of rock crystal (clear natural quartz) may be used to concentrate the ultra-violet rays from the iron spark and thus enhance their fluorescent effect.

Some substances, such as barium sulphide, continue to glow for a time after the exciting ultra-violet rays have been cut off, thus illustrating the phenomenon of *phosphorescence*, which is simply a persistence of fluorescence.

The rays that are produced by the iron spark, as above described, naturally contain a large proportion of visible light, and in certain cases, when a substance may show only a weak degree of fluorescence, the colour of the latter may be masked or overpowered to some extent by the visible light component. There are means by which the visible and invisible components may be entirely separated from each other, but the apparatus required for this is somewhat costly, and for ordinary purposes of illustration the visible light of the spark is not detrimental.

The spark between iron terminals should not be looked at by the unprotected eye on account of the danger of injury to sight from the ultra-violet rays. Ordinary spectacles or eye-glasses, however, provide complete protection if the lenses are *not* made of rock crystal. They can be tested in a moment by holding the lens between the iron spark and the fluorescent substance (preferably a piece of willemite). If the fluorescence is cut off by the lens it is made of glass, in which case the wearer may safely look at the iron spark, but if the green fluorescence of the willemite is not obscured by the lens it is made of rock crystal and will therefore afford no protection to the eye.

This outfit should be found especially valuable in physical and chemical laboratories and in many branches of research. As far as the writer is aware there is at present no other apparatus on the market that will produce equivalent effects.

NOTES AND ABSTRACTS.

RADIOTHERAPY.

The Technic of Deep Roentgen Therapy.—By JAMES T. CASE, M.D., and LLEWELYN L. JONES, M.D. (*American Journal of Roentgenology*, Nov., 1915).—Using the Coolidge tube, and carrying out experiments with four different makes of transformer and one 24-inch coil of foreign make, it was found that by increasing the parallel spark gap from seven to nine and a half inches it was possible to reduce the time of exposure one half. In other words, the increased penetrating power of the rays secured with the higher parallel gap gave the full dose reading, as measured by the Kienboeck photographic slips, under three millimetres of aluminium in one-half the time

required when the tube backed up only seven inches of parallel spark gap between points.

Before the Coolidge tube was available it was rarely possible to maintain a parallel spark gap greater than seven inches for more than a few minutes, using the water-cooled tubes; but with the new tube it is possible to maintain a gap of nine and a half to ten inches for a period which is practically indefinite. The writers have, in one day, with the same Coolidge tube, given an eighteen X dose measured under the filter in each of sixty areas, besides making sixty or seventy roentgenograms of the stomach, using screen plates.

In another series of experiments, in which the measurements were made by Kienboeck strips, carefully wrapped to protect from moisture and warmth, placed in the vagina and rectum in a patient weighing one hundred and fifty pounds, recorded one-twelfth of the reading of the Kienboeck slips placed on the skin but underneath the filter; that is, about one and one-half X for each eighteen X dose (under filter), measured on the skin. In other words, after a series of treatments measuring twenty X units of filtered ray to each of twenty-eight areas in a case of uterine myoma, the vaginal strips registered a total of forty X.

With the gas type of tube, the use of the rhythmeur was conceded to be a decided advantage, but with the Coolidge tube, the writers were unable to discover that it made any measurable difference whether the dose was given with the tube under constant excitation or with the current in the tube interrupted rhythmically by a device for this purpose. Accordingly the writers have given up the use of the rhythmeur.

The tendency all along has been to use the hardest possible rays. With the harder rays afforded us by the Coolidge tube, we have been able to shorten the entire time the patient was obliged to remain under treatment, the tangible results appearing very much sooner. Far greater accuracy and resulting uniformity was obtainable in our work, and cures and beneficial results were evident in cases which had heretofore baffled our efforts. Hence, at the present time our desire is for tubes which will permit still higher penetration than is afforded by those already at our disposal.

Frequent minor modifications have been made in our work since the technic of deep therapy employing the Coolidge tube was first worked out. The following is essentially the method now employed:

As above stated, our therapeutic work is now conducted exclusively with the Coolidge tube, so regulated that there is a fine brush discharge, with an occasional spark perhaps, between the points of the equivalent spark gap measuring nine and a half inches. With the older types of tube, we were unable to maintain this high resistance in the tube, but in our present work, there has not been the slightest difficulty in maintaining a parallel gap at the point named. The limit of nine and a half or ten inches was set only by the dimensions of the tube thus far furnished. We are informed that tubes with terminals sufficiently far apart to permit a greater parallel spark gap will soon be available for experimental and practical purposes.

It is probable that for ordinary purposes no cooling device at all is needed, but for continuous heavy treatment work it has seemed advantageous to cool the tube by an air blast which has been secured by a blast fan such as barbers use for drying the hair. This fan, connected with the ordinary lighting circuit, is mounted on a wooden tube support and so placed that the air blast falls directly upon the tube within its lead glass holder. It may be objected that this plan, which sometimes might cause unequal cooling of the tube wall, might result in cracking the tube, but no such accident has occurred in our work. The shortest distance between the tube and the fan should always exceed seven inches. Or, if preferred, one may enclose the tube in a specially constructed box with special device for air-cooling the tube.

It is frequently stated in the older text books that when using a hard tube, the focus-skin distance should be greater than when using a soft tube. At the present time the tendency is all the other way, viz., to diminish the focus-skin distance to the lowest possible figure. With the therapeutic tube stands now available, the focus-skin distance has been

reduced to six inches. In some locations it is impossible to bring the tube so close as six inches, but under all circumstances it is our endeavour to reduce the focus-skin distance to the minimum.

Understanding that we are speaking of deep therapy, all of our treatments are given through four millimetres of aluminium placed between the tube and the skin, preferably as near the skin as possible, but separated from it by a sheet of leather, the use of which was first advocated by Pfahler.

The time of exposure is variable, depending upon the dosage it is decided to give, upon the focus-skin distance, and upon the degree of penetration of the rays. In our work, employing the Coolidge tube excited by current from an interrupterless transformer (10 K.W. closed core, on 220 volt direct current), we found that with a focus-skin distance of seven inches and the tube of sufficient hardness to back up a nine and one-half inch parallel spark gap between points, irradiation for eighteen milliampère minutes caused the Kienboeck strips under the filtration above mentioned ten X when measured by the Gauss modification of the Kienboeck scale. The law that the intensity of the ray varies inversely with the square of the focus-skin distance has been found to hold absolutely, so that it has been found possible to construct a table which has enabled us to foretell, with reasonable accuracy, the reading of the Kienboeck strips, taking for granted the use of the Coolidge tube. It should be emphasized that these figures do not necessarily hold good for any other installation, although in our own work with three different types of interrupterless transformer, including both the open and the closed-core types, the figures are practically the same.

To Produce 10 *X under Filter of* 4 *mm. Aluminium Plus Sole Leather.*

(*Other conditions as above stated.*)

Focus-skin Distance	Milliampère minutes
7.0 Inches	18
7.5 ,,	21
8.0 ,,	24
8.5 ,,	27
9.0 ,,	30
9.5 ,,	33
10.0 ,,	37
10.5 ,,	41
11.0 ,,	45
11.5 ,,	49
12.0 ,,	53
13.0 ,,	62
14.0 ,,	72

In our earlier work, dosages of filtered ray amounting to from twenty-five to thirty-five X were given, but a larger experience has caused us to reduce the maximum irradiation (except in cases of malignancy) to eighteen or twenty X to each area during twenty-one days. In other words, except when dealing with malignancy no skin area should receive more than eighteen or twenty X units of filtered ray during a three-weeks period. Nevertheless, by using the cross-fire method, dividing the skin into numerous small areas and directing the ray through each skin area toward the objective point, it is possible to apply in one series a total dosage of 400 to 800 X of filtered ray, depending upon the number of areas available for irradiation. This dosage should not be repeated within twenty-one days; in fact, no more X-ray treatment of any degree should be permitted until the expiration of the three-weeks period. As stated in our preliminary remarks, the rhythmeur is not used.

It is obvious that the employment of the cross-fire method is only indicated in deep-seated lesions. In superficial disease the cross-fire plan is not only useless but it is without reason, and there is danger of omitting narrow strips of superficial tissue which need the irradiation.

The protection of the patient is a topic which demands a special consideration in therapeutic work. In roentgenographic work, the protection of the patient is a matter of minor consideration, no accident of any sort having occurred in our Roentgen department in either roentgenographic or roentgenoscopic work. However, in therapeutic work the protection of the patient is of paramount importance, especially on the side toward which the target of the tube points. The anode should always be turned toward the feet of the patient, or better still, away from the body. This may be accomplished by placing the tube obliquely across the body. The tube-holder should be provided with a lead glass bowl, or better still, a closed tube

box of the highest possible efficiency, such as is now upon the market for this special purpose. The diaphragm should permit the emission of a pencil of rays only large enough to cover the area to be treated. The various rubber aprons on the market are very variable in their effectiveness, and many of them are worse than useless. Each physician should carry out individual experiments to test the efficiency of the aprons upon which he depends for protection. Lead sheets are preferable, being of known efficiency. The writers employ sheets of lead, one-sixteenth of an inch in thickness, reinforcing the lead sheets when it seems desirable. The marking of the various skin areas should be done very accurately. Lead aprons or protection sheets should be fastened in place. The exercise of a little ingenuity will result in simple devices for supporting the weight of the heavy protection.

For the protection of the operator, the tube should always be turned so that the anode points away from the operator's booth. When using the harder rays afforded by the new tube, it is highly desirable to reinforce the lead lining of the booths upon which dependence has heretofore been placed. It is especially important that the lead glass through which the observer watches the patient should be reinforced. The writers use triple thicknesses of the best lead glass obtainable in each of their observation windows.

The hygiene of the X-ray room, as discussed by Alban Koehler and others, should be carefully considered. The ventilation of the operator's booth is especially important. Good ventilation of the treatment room will usually do away with the nausea which the patients sometimes experience.

In a number of cases, particularly cases of carcinoma of the breast, the X-ray treatment has been given through the open wound. Dr. A. L. Gray has reported a case of carcinoma of the bladder treated through an open suprapubic cystotomy wound. One of us has, for years, urged the treatment of breast cases through the open wound at the time of operation, and has made special arrangements for accomplishing the work quickly.

It is very important to recognize that no single skin area may receive more than eighteen or twenty X units of filtered ray within a three-weeks period without danger of overreaction. We must admit that the degree of tolerance varies with different individuals, but we are satisfied that a dosage of eighteen to twenty X is the limit of safety during a three-weeks period. Hence in deep therapy unless one deals with an urgent malignancy or takes special steps to desensitize the skin, the treatments should never be repeated in less than twenty-one days. When a benign process is being treated, the frequency of treatment may be extended to once in four weeks. A tanning of the skin following such vigorous treatments is to be expected, but under any other circumstances, any sign of erythema should at once be recognized as indicating a still longer interval between the treatments.

The patient should be made as comfortable as possible in every way. A soft couch may be substituted for the treatment table. Supports, as by a hoop device, for the heavy covers are very grateful. A pillow under the knees takes away considerable unnecessary strain on the leg flexors. The atmosphere of these rooms is likely to become very close; hence good ventilation should be secured by fans or other devices when necessary. Inasmuch as the patient passes long periods lying flat upon the table, face upward, concealed lights instead of the ordinary glaring open lights afford comfort. The therapeutic room should be made as nearly noiseless as possible. Much bothersome noise may be eliminated by placing the generator in an adjoining room. Some roentgenologists have it so arranged that the generator is in the basement underneath the treatment room. The high frequency discharges soon produce changes in the air which the writers believe is responsible for much of the unpleasant nausea experienced by many of these patients. At any rate, the nausea which frequently follows a series of X-ray treatments is very much diminished and often absent when pains are taken to keep the treatment room thoroughly ventilated. That the nausea is in part due to a degree of acidosis has occurred to us. Experiments are in progress upon this point, and a report will be given at a subsequent meeting.

The measurement of the dosage should be carried out with all the accuracy at our

command. Prior to the introduction of the Coolidge tube, the writers depended upon the Kienboeck or the Sabouraud scale and measured almost every treatment. Since the introduction of the Coolidge tube, providing one has a source of high potential which is sufficiently constant, the measurement of the dosage by means of the parallel spark gap, the focus skin distance and the time in milliampère minutes, is satisfactory. We prefer the Kienboeck scale to the Sabouraud for various reasons, principally that the use of the Kienboeck strips gives permanent evidence of the dose administered, providing the reading has been correctly taken. At the present time the writers frequently expose a Kienboeck strip more as a matter of a check upon the technic of the treatment than for actual measurement.

A number of cautions are necessary regarding the reading of the Kienboeck photo strips. It is important to avoid exposure of the photographic slips to heat. Most important of all, the temperature of the developer in which the photo slips are developed out should be kept accurately at 60° F. The Kienboeck method is probably the most reliable of all the photometric means of measuring the dosage, yet it is, on the whole, unsatisfactory because of a certain degree of inaccuracy which is necessarily involved in any photographic process; still it serves very well for comparison of results, especially for one's own work. In order to avoid the influence of the secondary rays, generated in the aluminium filter, upon the photo slip, the writers have, as a routine, slipped the Kienboeck strips into a leather holder before placing them underneath the aluminium filter.

If one applies a dosage of only ten or twelve X to each skin area, there will probably be no visible effect on the skin until after several series. If the limit of skin tolerance is approached, however, as when a limit dose of 20 X is given, there will appear within a few weeks a ruddy bronzing of the skin. This tanning lasts for months, but finally fades away.

SURGICAL RADIOSCOPY.

Surgical Radioscopy under Red Light.— *Archives d'Electricité Médicale,* No. 398, 1915, and No. 401, 1916.—Bergonié favours the practice of surgical radioscopy in a darkened operating room, with the operating field illuminated only by an intense and saturated red light. At a certain illumination of monochromatic red light, giving no green or yellow rays, which are the radiations emitted by the fluorescent screen when struck by X rays, not only can the surgeon and his assistants operate easily, but they conserve and even increase their visual acuity during the operation, not only for objects seen under the red light, but also, by the effect of contrast, for the green radioscopic images when the red light is switched off. No interval of darkness is necessary between the suppression of the red light and the illumination of the screen, and the method has the great advantage that the surgeon and all his assistants can see the radioscopic images, and do not depend upon the single radiologist with his fluoroscope. Once the indications furnished by this momentary radioscopy have been obtained, the screen is put on one side, and the operation continued in red light. The monochromatic red light is furnished by a luminous ceiling, the light from 20 lamps of 25 c.p. being filtered through two thicknesses of the ruby glass of commerce. The number of times it may be necessary to switch off this red light and recur to the screen varies according to the nature of the case. It may be twice for the localization of a piece of shrapnel in the heel, and half a dozen times for a foreign body in the neck of the femur. Allowance must be made for the difference in tint, under the red light, of arterial blood, and venous blood, and the first signs of asphyxia, which last takes almost a black colouration. In another paper, in the same journal, Monod gives some details of the method he employs. He first takes a radiograph to show the general situation of the foreign body. He finds that some ten minutes are necessary in order to obtain a sufficient visual adaptation for the red light, but after that the surgeon is equally able to appreciate the objects seen under the red light, and, immediately the red light is switched off, the radioscopic images. By means of a forceps, the positions given by the screen are fixed until the actual operation is resumed, and with each fresh radioscopic control the forceps

penetrates more deeply into the wound, indicating the path for the surgeon's instruments, until at last the foreign body is reached. Sometimes the foreign body may be seized directly between the jaws of the forceps; more frequently it is the fingers of the operator which guide its actual extraction. It is a great advantage, the author thinks, for the surgeon to be able to conserve his entire independence from first to last. He himself only uses the method, however, for non-magnetic projectiles (preferring to use a Bergonié electro-vibreur in other cases), and these interventions for non-magnetic projectiles, he says, account for only some 17 per cent. of the total number of operations for embedded foreign bodies.

The Extraction of Foreign Bodies under Intermittent Control of the Screen. (*Bulletins et Mémoires de la Société de Chirurgie*, No. 4, 1916.)—Brin, comparing the ordinary method of performing operations on radiographic or radioscopic indications previously furnished, with that of working under radioscopic control during the actual intervention, decides strongly in favour of the latter. He says that by the first procedure he has missed many projectiles, and in some cases the findings were so ambiguous that he has not even attempted the search. With the intermittent radioscopic control during operation, however, he has only missed one projectile in 117 attempts. The author believes that the method of intermittent radioscopy during operation is not sufficiently well known. For his own part he has found it very satisfactory, and among the projectiles he has extracted by this means have been many which eluded very expert surgeons who had been guided by independent radiography or by the electro-vibrator. The great superiority of intermittent radioscopy is its suppleness, adaptable as it is to all the operative positions, however much these may vary in the course of the intervention. It suits the stages of the operation without inconveniencing the surgeon.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

ON THE RADIOGRAPHY OF THE BRONCHIAL GLANDS.

By Walker Overend, M.A. (Oxon), M.D.
Chief Assistant in the X-ray Department, St. Bartholomew's Hospital, London; Honorary Radiologist to the East Sussex Hospital, Hastings; late Physician to the Prince of Wales' Hospital, London, N.;

AND

Clive Riviere, M.D. (Lond.), F.R.C.P.,
Physician to the Victoria Park Hospital for Diseases of the Chest, and to the East London Hospital for Children.

I. Introduction.—The present communication[1] includes an abridged account of an inquiry, undertaken for the Local Government Board, into the clinical and radiological diagnosis of intrathoracic tuberculosis in children of school age. Sixty-one children, between the ages of five and ten years, were selected from the County Council Schools and tuberculosis dispensaries so as to constitute three classes, A, B, and C. In the first class no possible source

1 A résumé of the investigation dealing more particularly with the clinical data has been sent for publication to the *Lancet*.

of tuberculous infection could be traced within the home ; in the second, children were included who had been exposed to such infection for comparatively limited periods (one year or less) ; in the third, the probability of communication had existed for long periods, and in many cases of this class one or both parents had died from the disease.

II. Anatomical Remarks.—Since tuberculosis in childhood, in its early stages, is essentially a disease of the lymphatic glands, it is necessary to define the topography of these structures within the thorax. Although they form a more or less continuous chain lying along the trachea and larger bronchi with their branches, it is convenient to divide them into three or four groups, viz. :—

(*a*) *tracheo-bronchial*,
(*b*) *bifurcation*,
(*c*) *hilum*, and
(*d*) *pulmonary*,

or the two latter may be combined under the name *broncho-pulmonary.*

The *tracheo-bronchial* form a collection situated in the angle between the trachea and the extrapulmonary bronchus, and are more numerous on the right side.

The *bifurcation* glands (sometimes termed inferior tracheo-bronchial) extend principally along the under surface of the right extrapulmonary bronchus, but a few retain closer connections with the left. The right lie immediately behind the right pulmonary artery, only a layer of pericardium intervening.

The *hilum* glands lie buried within the pulmonary parenchyma at the root of the lung, while the pulmonary glands extend into the lung as far as the fourth divisions of the bronchi. They occupy the site of bifurcation of the bronchi, and come into close relationship with branches of the pulmonary artery which pass through the angles of the bronchi at their divisions. The lymphatics of the lung and pleura converge from the periphery towards the root—the upper and middle areas draining into the tracheo-bronchial, the middle and lower into the bifurcation glands, and thence into the tracheo-bronchial. Radicles connect these glands with those of the opposite side and with the supra-clavicular group.

III. Clinical Results.—(*a*) The sixty-one cases may be separated into four groups, viz. :—

Group I, *normal* with no physical signs ;
Group II, with *right paravertebral dulness ;*
Group III, with *double paravertebral dulness*, and
Group IV, showing *parasternal dulness* of one or both sides.

Some cases will fall into two or more groups. Along with right paravertebral dulness (Group II), there is in addition slight relative impairment over the upper part or the whole of the right lung, and the breath-sounds may possess a blowing quality at the right apex.

Group III appears to be a further or advanced stage of Group II, in which

the disease has spread to bifurcation and bronchopulmonary glands along the left bronchus and its divisions.

In Group IV the dulness is apparently due to enlargement of the tracheobronchial glands. Normally, in children of the ages examined, there exists about one centimetre of impairment on each side of the sternum, and this may be increased even to four or five centimetres when caseation of tracheobronchial glands is present.

(*b*) *Implication of the lung.*—Evidence of lung involvement is notoriously difficult to ascertain from physical signs in central disease spreading from the glands—the form occurring in children. Direct evidence of lung infiltration —dulness, crepitations, and blowing sounds—could be obtained in very few of the cases; and for the most part, such *moist* sounds as were present appeared open to other explanation. Since an inquiry, as to symptoms, was ruled out in this investigation—except so far as nutrition is a symptom— there remained but one sign whereby it seemed possible to discover the presence of active lung disease, namely, the *reflex areas* of percussion impairment described by one [2] of us as present in cases of pulmonary tuberculosis, and claimed as evidence, when found, of recent parenchymatous irritation (? inflammation). Among the members of Class A, eight showed these bands, and, in one of them, râles over the lung were present in addition. In Class B, with limited household infection, seven exhibited the reflex bands. Only in two children of Class III were the bands present, suggesting that with longer exposure the active processes have time to decline. Blowing apical breath-sounds were strikingly present in six, in all, on the right side. Only one of these children showed evidence of activity. In the remainder, glandular disease or a healed infiltration appeared to be responsible.

With regard to added sounds, râles and crepitations, their significance is doubtful. Out of twelve cases in which râles and crepitations were audible, the reflex bands were present in nine. In the remaining three, they were bronchitic in origin. The presence of activity and of the reflex bands was supported by radiological examination. In a few children, fine indeterminate crackles, superficial sounding, often of a fleeting character, were heard around the nipples or near the lung-bases. They appeared to be of mixed causation, dependent either on pleuritic involvement, or upon the presence of areas of œdema, the result of lymphatic obstruction.

IV. Radiological Observations. — (*a*) *Method of examination.* — Each child was examined and radiographed in the dorso-ventral, ventro-dorsal, and right semi-lateral positions. In the oblique diameter, with a small metal disc placed on the fifth dorsal spine, it is noticed that an attitude situated between the mid-oblique and lateral is more suitable since it provides an increased width of the posterior mediastinum.

By means of the screen four types are recognisable :—

(*a*) The *normal* with good trans-illumination and clear pulmonary fields,

2 Riviere. *Lancet*, August 21, 1915.

(*b*) The *cloudy*, with poor transparency (congestion of vessels, and lymphatics, pleuritic veil, etc.),

(*c*) The *granular and clear*, containing numerous maculæ, but illuminating well on deep inspiration, and

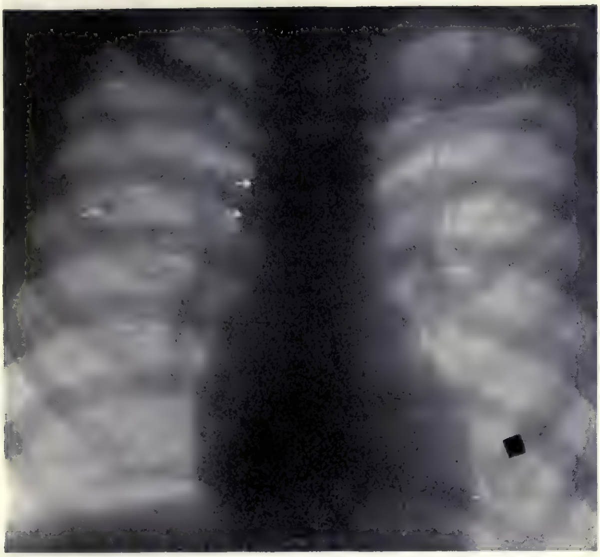
(*d*) The *granular and cloudy*. With certain reservations the length of exposure to tuberculous infection may be roughly estimated from the dulness of the screen.

(*b*) *Diagnosis*. (1) *Tracheo-bronchial opacities*.—When these glands are diseased a shadow is seen outside and parallel with the sternum, occupying the level of the second, third, and fourth posterior interspaces. If the disease is of long duration, and quiescent, the margins are well-defined, and denser oval opacities may be visible within the general shadow. For diagnosis its intimate relation with the trachea and extrapulmonary bronchus is decisive. An examination of oblique radiograms shows that these glands when enlarged tend to spread forwards as well as laterally. On the left side they are fewer in number, and being situated behind the arch of the aorta are not so easily visualised. They must be differentiated from (*a*) the bend of the aorta, (*b*) enlargement of the thymus gland, (*c*) dilatation of the conus and left auricle.

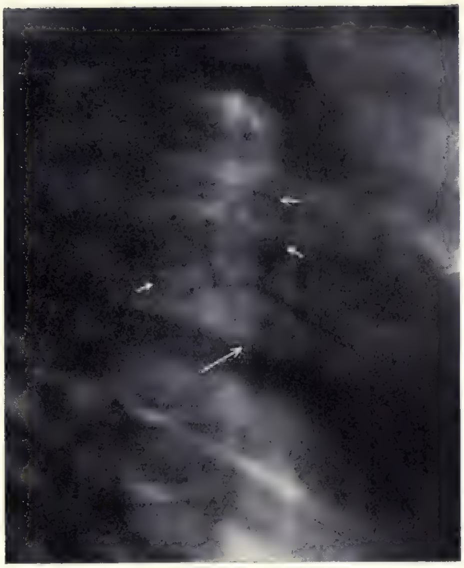
(2) *Bifurcation glands* are practically invisible (owing to the cardiac shadow in the antero-posterior positions) except in the oblique picture. For a positive diagnosis the two limbs of the bifurcation must be discernible with the shadows in close connection with one or both. The right bronchus runs across the cardiac shadow, the left towards the spine. When recently diseased the whole space between the limbs of the fork appears to be occupied by a diffuse woolly opacity : later, one may discern in good radiograms—more easily in adults, since the area of the interspace is increased—which of the two groups, right or left, is particularly affected. A linear opacity running longitudinally at a short distance from the spine, and seen on the screen to pulsate with the cardiac systole, localizes the posterior border of the trachea. It seems probable that a mediastinal lymphatic trunk runs upward in this situation towards the clavicle. This linear opacity is also observed in the adult when the central glands are enlarged, as in adult bronchial-gland tuberculosis, and when neoplasms implicate the posterior mediastinum.

(3) An increased hilum-opacity may be irregular in outline and contain deeper shadows within it. If the appearance is one of diffuse cloudiness with faint external margins, merging gradually into the pulmonary fields, activity is present. Sometimes the border is convex, and lines radiate in a fan-shaped manner towards the periphery (clavicle, axilla, lateral walls, and diaphragm). Peribronchial foci, in excess, may be visible close to the circumference of the hilum-shadow, and there may be signs of fusion to form bronchopneumonic areas.

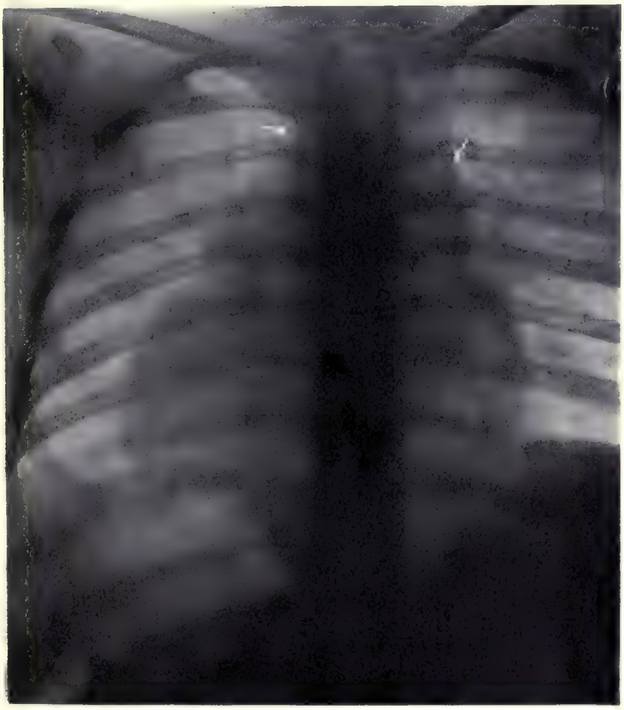
(*c*) *Remarks concerning each class.* — Of the twenty-three members of Class A, only three, from a radiological point of view, could be said to possess a normal chest, the signs of which are :—



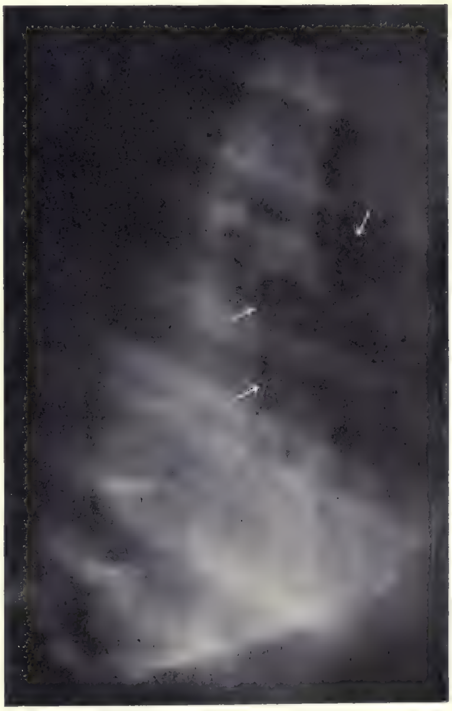
No. 1, æt: 9, class 1, group I (clinically normal).—Two calcareous glands in lower portion of tracheo-bronchial shadow. Small calcareous focus in lower part of right upper lobe (primary).



No. 2.—Right oblique radiogram of No. 1 with calcareous tracheo-bronchial and bifurcation glands, and an interlobar stripe.



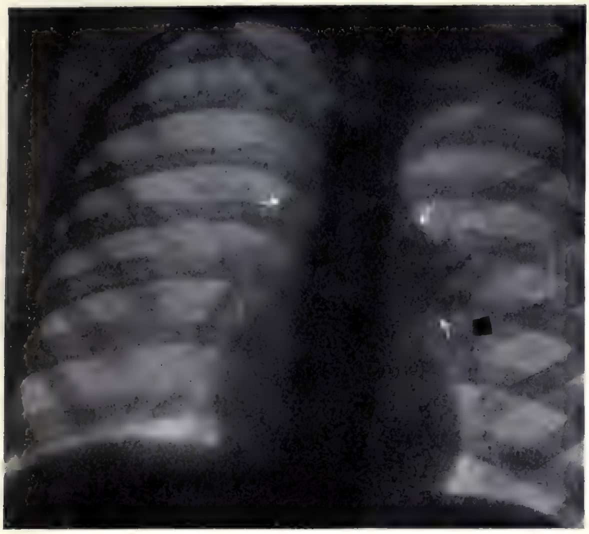
No. 3, æt: 8, class 1, group II.—Ventrodorsal. Tracheo-bronchial opacities with well-defined edges. Evidence of infiltration of right upper lobe posteriorly. In oblique position calcified bifurcation glands.



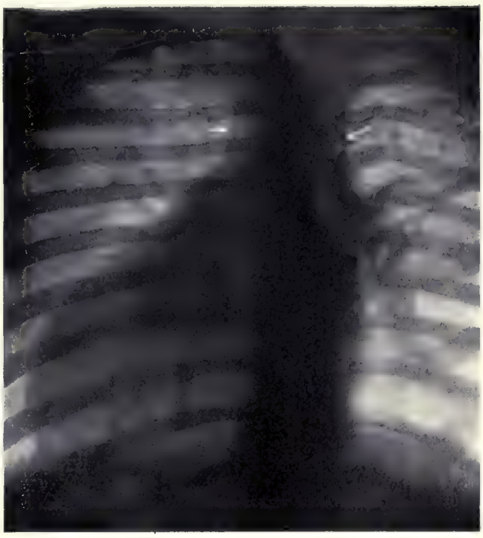
No. 4, æt: 8, class 3, group IV.—Right oblique radiogram showing bifurcation of the trachea, with calcified glands in the right tracheo-bronchial and bifurcation opacities.

RADIOGRAPHY OF THE BRONCHIAL GLANDS.

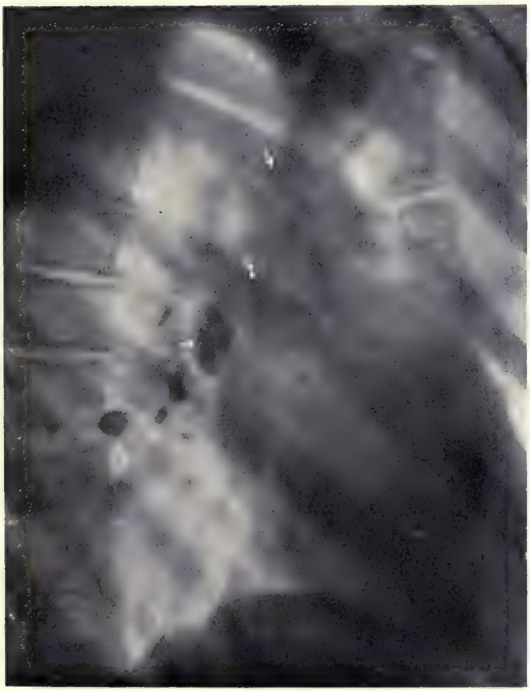
PLATE 14.



No 5, æt: 7, class 2, groups III and IV.—Right and left tracheo-bronchial opacities conspicuous. Entire lung permeated by networks containing tuberculous foci. Bifurcation opacity indefinite and woolly. Some infiltration of hilum.



No. 6, æt: 8, class 3, groups II and IV.—Clinically active; Hilum infiltration.



No. 7 and No. 8, from same individual, æt: 40 years.—No. 7, right oblique, No. 8, left oblique, showing calcareous bifurcation and tracheo-bronchial glands.

RADIOGRAPHY OF THE BRONCHIAL GLANDS.

PLATE 15.

(1) Translucent pulmonary fields with good illumination on deep inspiration.
(2) Proper movement of the ribs and diaphragm.
(3) A radiogram with insignificant hilum-opacities, and, at the outside, only a few radiating peribronchial striæ accompanied by a trivial number of small and obsolete focal shadows.

Of the remainder in Class A, twelve (52 per cent.) showed clinically no signs of activity, but many of these exhibited striking evidence of extensive old healed peribronchial infection, conspicuous striation, arrested caseous or

No. 9.—Adult æt: 24, with central glandular tuberculosis. Uppermost arrow indicates the mediastinal linear opacity; the middle the right tracheo-bronchial shadow; the lowest arrow the homogeneous bifurcation opacity. (In both cases glands inflamed and hypertrophied.) Note bifurcation of trachea and of right bronchus.

calcareous foci, and caseating or calcareous tracheo-bronchial and bifurcation glands. (*Peribronchitis tuberculosa latens.*) In radiograms 1 and 2 (child æt. 9) a small, now calcareous, primary (?) focus is seen in the lower part of right upper lobe, and in association with it a double calcareous opacity in the lower part of the right tracheo-bronchial shadow. Eight of the twenty-three (35 per cent.) showed definite radiological signs of activity. Among the children of Class B, with short contact, nine (47 per cent.), and of Class C, six (31 per cent.) manifested signs of active disease.

V. The Correlation of Clinical and Radiological Results may be conveniently discussed under three headings, viz. :—

(*a*) the glands,

(*b*) the lung, and

(*c*) the presence of active disease.

(*a*) The clinical evidence of the involvement of tracheo-bronchial groups of glands was in every case confirmed by radiological examination. With a few exceptions the bifurcation glands were visible in the oblique radiogram, sometimes as obvious shadows where clinical examination failed to show paravertebral dulness. Evidently a decided amount of enlargement is required before the effects of *pressure* become physically demonstrable.

(*b*) *The Lung.*—In hilum tuberculosis—the common form of dissemination in childhood at least—the deep areas of lung affected in the early stages lie entirely beyond the reach of clinical diagnosis—stethoscopic signs being absent until the process extends nearly to the surface. Moreover, contrast dulness to percussion only becomes manifest when the disease is markedly unilateral. When a condition of activity is present, symptoms *alone* may indicate its probability in the central areas ; moreover, the occurrence of the reflex bands of impairment may confirm its presence. When quiescent, clinical signs may fail entirely, and radiological examination becomes invaluable and indispensable. In one case, in addition to the signs of Groups III and IV with the reflex bands of impairment, blowing breath-sounds were marked at the right apex. Radiological examination showed enlarged woolly bifurcation glands, a right tracheo-bronchial opacity with indefinite margin, and numbers of peribronchial foci in the right pulmonary fields coalescing below into bronchopneumonic foci, with a general dulness of the right side to the rays. Other cases showed signs of activity, clinically and radiologically, but the extent and locality of the disease was only seen upon the radiogram. Some children were entirely normal to clinical examination, and still showed conspicuous signs of unilateral or bilateral arrested disease. In some the pulmonary fields were closely beset with old peribronchial reticula and pin-head sized foci, sometimes extending to the extreme periphery of the lung.

(*c*) *The evidences of activity.*—With the exception of three cases the results of physical and radiological examination were in accord ; in other words, the signs of X-ray activity were not, in every case, supported by clinical observation. Possibly these were either incipient or were on the border line between activity and arrest. When the osseous framework of the chest possesses clear, definite outlines, the radiogram may be employed for the solution of the problem. Old and arrested foci possess sharp outlines and denser shadows. When the disease is active, tracheo-bronchial or bifurcation opacities are cloudy, or woolly ; their margins are either irregular or indefinite and faint. The intensity of the shadow is feeble and homogeneous. There may be a haziness over the pulmonary fields, and the separate foci visible may appear vague and blurred, as if seen through a stratum of fluid. The connecting reticulum may be absent. A diffuse uniform appearance of the hilum-

densities is suggestive of activity, and may be accompanied by an indistinct mottling of the adjacent pulmonary field, spreading towards the axilla. This is best seen on the ventro-dorsal plate. In two children, the subjects of chronic bronchitis, the pulmonary fields were covered by a dendriform arrangement of fine lines, with a few foci only. Numerous peribronchial foci, of weak intensity, scattered around the hilum, coalescing in places to form bronchopneumonic patches are indicative of activity. There may be an excessive number of thickened lines radiating towards or reaching the extreme periphery of the lung. The obviously active cases clinically are recognisable without difficulty on the radiogram. One of the earliest signs of active disease appears to be an intumescence and cloudiness of the central groups of glands. As might have been anticipated, the children of Class B (short contacts) exhibited the greatest percentage of active cases (47).

VI. In Conclusion.—The following deductions, already to some extent recognised, became forcibly impressed upon us during the course of the inquiry :—

(*a*) The wide-spread distribution of thoracic tubercle in children of school age in thickly populated urban districts, and its constant occurrence in the case of household infection.

(*b*) The notable powers of resistance which can control these processes even after extensive dissemination throughout the lung, and the comparatively slight effects they exercise on health and nutrition.

(*c*) The serious chances of recrudescence, under conditions of stress, which these children must carry with them into adolescence and adult life.

(*d*) The mutual interdependence of clinical and radiological methods of examination in the complete investigation of the tuberculous thorax.

A NOTE ON RENAL CALCULI WITH AN ACCOUNT OF AN INTERESTING CASE.

By C. Thurstan Holland,

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At the Seventeenth International Congress of Medicine in 1913, in the section of Radiology, I submitted a paper,[1] " On the Statistics of the X-ray Examination for Stone." This was based on the results of over eight years, and an experience of 1,707 consecutive cases.

It was pointed out in this paper that, from a practical point of view, errors of diagnosis as regards the actual showing on an X-ray plate, or plates, of the shadow of a stone—if one were present—was almost nil as regards the kidneys and ureters ; but that in the case of the bladder the possible presence

1 **"Section of Radiology," Section XXII., page 87.**

of pure uric acid calculi—invisible by X rays—had always to be borne in mind. Such stones, even of large size, being met with in this organ not altogether infrequently.

Experience since that paper was published has not only confirmed these statistics, but has emphasized the point that kidney and ureter stones so invariably show on X-ray plates, that any error from this point of view may be ignored. The very rare pure uric acid stone in a kidney or ureter need not be considered, and, with proper technique and care, all other stones should be shown. The only exception to this is that occasionally the shadow of a small stone may be superimposed upon the shadow of the bones of the sacro-iliac region, and thus escape notice.

Again it can be stated, as was stated in that paper, that not once (during the past eleven years) has a stone been found at operation which did not show on a plate previously exposed. Only once have I met with a stone of what might be described as of " surgical size " (and this one was afterwards passed per urethram) which, at the time of the X-ray examination, was almost certainly in the kidney, and which did not show on good plates. This stone on subsequent examination was found to consist entirely of uric acid and moisture, no other constituent of any kind being present. It is to be noted that this calculus was not too large to be passed.

The prevalent idea that uric acid stones are the commonest, or even commonly met with, is entirely misleading. Many years ago, before the X-ray diagnosis of stones was anything more than an X-ray curiosity, a certain eminent radiologist toured Europe with a collection of small calculi, fixed in a box under a glass cover, and these were stated to be uric acid stones shown by X rays, and afterwards either passed or removed surgically. I always doubted this statement, and after collecting a large number of stones from kidneys and ureters, I persuaded Mr. Thelwall Thomas (from whose cases they came) to have them properly analysed. The results of these analyses were published,[2] and were most instructive. Many of the stones picked out had the naked eye appearances of these so-called uric acid stones. In the whole series examined 11.9 per cent. was the greatest amount of uric acid present in any one stone, and many had no uric acid in them at all. Further experience has only tended to confirm these observations, and the results of the X-ray examinations, of the operations performed, and of the passage of various stones, has proved to my mind that the " uric acid stone " of surgical size exists so rarely in a kidney or a ureter that for diagnostic purposes it may almost be ignored.

To say that a stone is, or to describe it as, a uric acid stone, because it contains uric acid in small quantity, is an absurdity, and yet this is the attitude of some writers. A mixed calculus should be described as such, or at any rate should be described under the name of its most prominent constituent. Whilst from the X-ray point of view only, exactitude in this respect is of paramount importance.

2 "The Liverpool Bio-chemical Journal," 1908, Vol. III., page 346; and ditto, 1910, Vol. V., page 161.

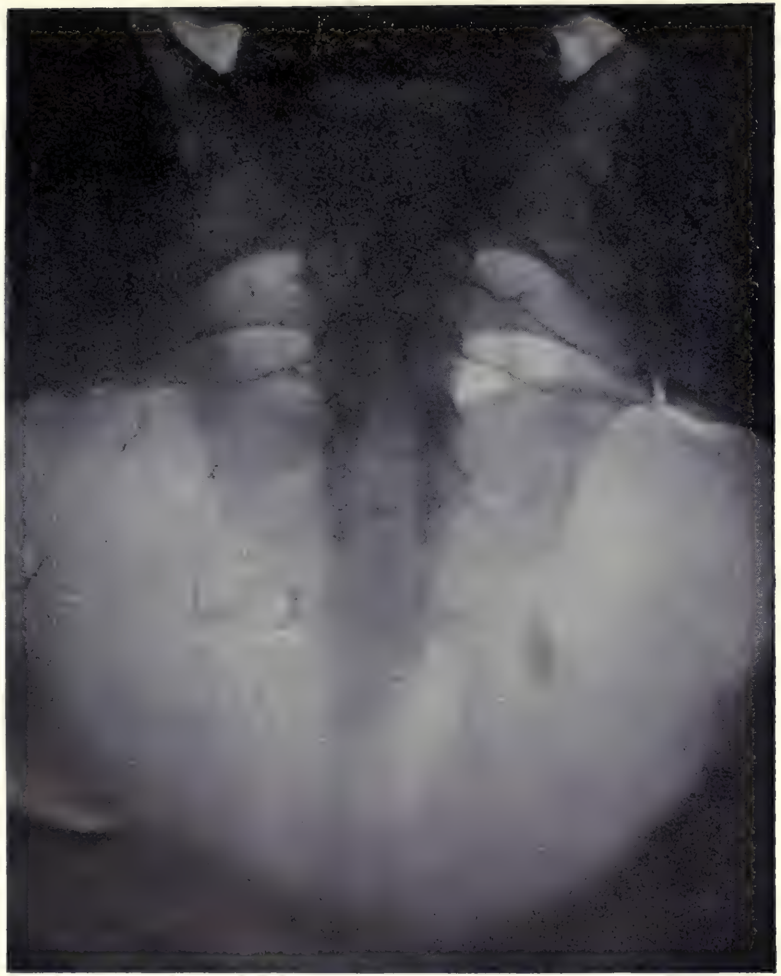

FIG. 1.—Dermoid cyst in right pelvis. Tooth in cyst simulating stone in the lower right ureter.

FIG. 2.—Radiograph of dermoid cyst and contents after its removal.

PLATE 16.

This leads me to the second point, namely, that X-ray errors are not those of "showing shadows," but of the "interpretation of these shadows." Now we are on entirely different ground. Years ago it was only necessary to show an X-ray shadow anywhere reasonably in the region of a kidney or ureter, and the conclusion at once was a calculus. At the present time, with increased and varied experience, the tendency is almost the other way ; and, unless the shadow has distinct and absolutely diagnostic characteristics, the X-ray expert who has followed up his cases, and who has a retentive memory for mistakes, must be always up against himself, so to speak, and will have doubts as to what the shadow is really due to.

As a rule, the kidney stone itself does not give rise to difficulty, although even with these difficulties and errors of diagnosis must occur, and the man who does not confess to having made such mistakes had better give up X-ray work. Nothing is more annoying than to make these mistakes, but there is perhaps more to be learnt from mistakes than from successes, and they should be noted and remembered.

Ureter stones, on the other hand, are a great and often insuperable difficulty. Many from their shape and position, and other slight characteristics of the shadow, are obvious, and the diagnosis may be made with certainty. Many are doubtful. Many are so different from the usual that they suggest other things. The catheter, the cystoscope, the separation of urine, collargol, stereoscopic radiographs, and all the other devices still occasionally fail to clinch the diagnosis, and only operation reveals the yes or no of the question.

All radiologists and many surgeons know the common sources of error, calcareous glands, phleboliths, calcareous patches in the ligaments, and so on. Other and still rarer conditions occasionally make for error.

The following case, worthy of record, I think, emphasizes in a striking degree how things can go wrong.

A woman aged 42 years was sent to the X-ray department of the Liverpool Royal Infirmary by my colleague, Dr. Abram, for an X-ray examination for suspected stone on the right side. The usual four plates covering the whole stone area on both sides were taken and submitted to me. The shadow shown in the plate of the pelvic region, and reproduced in Fig. 1, was the only shadow to be considered. The symptoms are interesting. Pain in acute attacks over a period of ten years on the right side, associated with pain on micturition and vomiting, and followed by the passage of large quantities of urine. Latterly the attacks had increased in severity. The right rectus was somewhat rigid, but the right kidney was apparently felt and taken to be movable. The urine contained no pus and no albumen, but a few blood cells were reported.

I reported to the effect (knowing the symptoms, etc.) that an elongated shadow showed in the pelvic plate on the right side; that its somewhat blurred outline, the line of its long axis, and the general appearance, suggested a stone in the lower right ureter, but that it was not quite in the

exact ureter line. (It might be remarked here in parenthesis that it is not altogether unusual in the case of ureter stones to find that, as a result of a stone being present, the usual line of the ureter is altered. I have seen this fairly often.)

Mr. Jeans, to whom the case was then referred, in view of this report took further precautions before operating. Indigo-carmine was given, and a cystoscopic examination showed that whilst the blue urine from the left ureter came down in regular and normal spurts, that from the right (the affected side) trickled through continuously in a small stream—there were no jets at all. Following on this, a catheter was passed up the left ureter normally, whilst on attempting to pass it up the right it hitched at two inches from the bladder, was coaxed on, hitched again at five inches, was again coaxed on, and finally passed up to the kidney.

This was considered good enough evidence for operation. In the Trendelenburg position the right ureter was exposed and opened, instruments passed into the bladder, and nothing found. A further examination was then made, and resulted in the finding of a tumour in the abdomen high up in the kidney region on the right side, the size of two oranges. This tumour after removal proved to be a dermoid cyst with a long pedicle, so long that it could take up any position in the right abdomen and pelvis. An X-ray examination showed the shadow seen in Fig. 2. On examination the cause of this shadow turned out to be an immature tooth.

On page 246 of Knox's text book on Radiography, etc., is a series of radiographs of a dermoid cyst in the pelvis, but in this case it contained a large collection of teeth, which, whatever else they were, could not be mistaken radiographically for stones. Cases of this kind must be of extreme rarity, especially when the symptoms are also misleading, and it is difficult to see in the case related how an error could have been avoided.

MEDICAL DIATHERMY.

By medical diathermy is meant the elevation of the temperature of the whole body, or of part of it, to a degree insufficient to destroy or impair the vitality of the tissues.

The apparatus which generates the diathermy current and the properties of the latter have been considered in earlier numbers of the Archives (Nos. 168, 169, 170, 172). The following pages will be devoted to an account of the methods of carrying out medical diathermy. Surgical diathermy, *i.e.*, the heating-through of tissues to a degree sufficient to destroy them *in situ*, has already been described, with notes of cases, in Nos. 174, 176, 179.

To apply diathermy to the body for medical purposes we require electrodes

or a form of condenser couch. Electrodes are generally used when *local* treatment is desired, the condenser couch when *general* treatment is desired, but electrodes may be used for general treatment also, whilst local treatment may also be applied on the couch.

Medical Electrodes.—These can be made of sheet lead. This metal is sufficiently pliable and can be bent so as to make even and uniform contact with different parts of the body where the surface is smooth and not irregular. $\frac{1}{24}$ inch (1 mm.) is a suitable thickness, and the following are useful stock sizes :—

Circular, 4 cm.; 6 cm.; 9 cm. in diameter.
Rectangular, 4 by $6\frac{1}{2}$ cm.; $4\frac{1}{2}$ by 10 cm.; 5 by 12 cm.; 10 by 20 cm.
Square, 15 by 15 cm.; 20 by 20 cm.

These electrodes are for application to the external surface of the body.

Mode of Application.—They can be placed either in direct contact with the skin or with an absorbent pad, thoroughly soaked in salt solution, interposed.

It is of great importance that the electrodes should make even and uniform contact with the skin at all points, otherwise the current will be stronger at some parts than at others and burns may be produced. Such contact can be easily made where the external surface of the body is flat, or evenly curved, as in the region of the abdomen, thighs, etc. When, however, the surface is uneven and irregular, as on the knee, ankle, etc., even contact cannot be obtained with metal plates, so that it is necessary to interpose moistened pads.

If bare metal electrodes are placed in direct contact with a very dry skin, the patient may feel a tingling sensation like that experienced when a faradic current is passing. This faradic sensation may be abolished by slightly damping the skin with water. If the skin is covered with hair it is necessary to interpose the moistened pad, otherwise a very disagreeable prickling and burning sensation will be felt.

The pads may be made of felt or of layers of lint. A quarter of an inch is a suitable thickness. They must be soaked in strong solution. Tap water will not do because it offers too high a resistance to the current. Its temperature rises and the skin may easily be scalded. If a thermometer is placed in the pad the rise of temperature may be noted. Burke and MacGregor made some observations on this point at St. Bartholomew's Hospital. When the pads were soaked in tap water a gradual rise of temperature was noted, till it became unbearable, and the current had to be lessened or switched off. They found that if salt were added to the water, about one tablespoonful to the pint, the temperature did not rise beyond 98·4° F. after applications of the current lasting for half an hour. The strength of the solution should be such that the temperature of the pad should not rise higher than that of the skin when the latter is heated by the current. The pad should therefore be heated, not by the current, but merely by passive conduction from the electrically heated skin. Two tablespoonfuls of salt to the pint of water would make a solution of amply sufficient strength.

It may be asked whether it is better to use dry metal electrodes or inter-

pose a moistened pad. If the skin remains dry during the passage of the current its resistance will be higher than that of the underlying tissues, and, in consequence, it will be more heated. If, then, it is desired to raise the skin to a higher temperature than the underlying parts, it is better to use bare metal electrodes.

Situation of the Electrodes.—In order that the part to be treated may be heated through in its entirety it is necessary that the current should be evenly distributed through it. To bring this about, as far as it is possible, it is necessary to arrange the electrodes in suitable positions. The current flows in larger part along the shorter path. Supposing that the electrodes are placed, side by side, on a flat surface, the major portion of the current will flow through the part lying between the edges that are closest together, and it is unlikely that it will pass deeply below the skin. The parts lying under the electrodes away from the edges will receive less and less current as the distance between them increases, and consequently less and less heat. Thus, if it is wished to heat the knee joint throughout, the electrodes should not be placed one above and one below. They should be placed on opposite aspects, one in front and the other behind, or one on each side. When fixing them in these last-mentioned positions it is necessary to arrange that they are, as far as possible, equidistant. If they are wide and pass too far around the circumference, the edges of one will come too close to those of the other on the opposite side, and when the current is flowing, the major portion will pass through only a small and superficial part of the joint in the region of the closely opposed edges. If the electrodes are reduced in size so as to lie in a relatively equidistant position, some of the joint would be uncovered and would receive little or no current. If, however, after the first application of the current to the joint, the position of the electrodes is altered so that the current flows now in a direction at right angles, the whole of the joint will have received current and be warmed throughout. This is the "cross-fire" method of applying the current. It secures the elevation of the temperature in the interior and more central part of the joint, as well as in the exterior part.

If the electrodes are made to encircle the limb, one being placed above, the other below the joint, the "edge effect," as it may be called, will again be produced ; the larger part of the current entering the limb in the region at the edges of the electrodes where the latter are closest together and passing more superficially. The further apart the electrodes are placed, above and below, the less is the edge effect, and more current will pass to the deeper parts of the joint, but the tissues above and below the joint will be heated as well as the joint itself.

If the electrodes are placed one above and one below a joint, and the latter is flexed, the shorter path for the current will be along the flexor aspect, and consequently one part of the joint will be heated more than the other. If a patient is sitting on a chair with legs bent, and one electrode is placed on the back or front of the thigh, the other on the back or front of the leg and the

current allowed to flow, the greater heating of the popliteal space will be apparent alike to patient and operator.

If one electrode is placed on the sole of the foot and the other on the leg, the toes will receive practically no heat, and the anterior portion of the foot scarcely any, because the majority of the current passes through the ankle and that part of the sole lying just under the ankle. The inappreciable heating of the former parts is apparent when the foot is blue from sluggish circulation. The skin around the ankle gradually becomes pink, while the toes retain their livid appearance. To heat the toes and the front of the foot the electrodes should be placed, one on the dorsum, the other on the plantar aspect. In the case of the hand and fingers the electrodes should be placed in a corresponding position.

When it is desired to apply diathermy to large sections of the body, such as the chest or abdomen, large electrodes have to be used. The current then passes through a large section of the body, and, as the resistance is proportionately low and the current-density small, only a slight rise of temperature would result. Greater heating can be effected by using the diathermy condenser couch. This has been described and illustrated in the ARCHIVES (No. 169). One of the electrodes is placed on the part requiring treatment: the other consists of a sheet of metal fixed on the couch, but covered completely by a sheet of ebonite. The patient lies on the latter. The sheet of metal under the ebonite being of large size acts as an indifferent electrode, and the parts that lie over it will be inappreciably heated, but the parts under the active electrode will receive a considerable degree of heat. If it is desired to heat the chest or abdomen more uniformly through, the best method would be to dispense with the couch, and use two active electrodes, one in front and the other behind, and interpose between one of them and the body a sheet of ebonite $\frac{1}{8}$ inch thick. The separation of one electrode from the skin by the insulating layer would prevent the passage of a continuous, one-direction current. The diathermy current is, however, oscillatory, surging to and fro, with high frequency, between the machine and each side of the insulating plate and so traverses the body on the side in contact with the plate.

Avoidance of risk of burns. Maximum safe current-density.—The above-described are methods of applying diathermy *locally*. The patient's sensations are a sufficient guide to the operator to enable him to avoid the use of too strong a current and the consequent risk of burns. The current should be increased gradually till the patient first feels the sensation of warmth. It takes a few minutes before a current warms the tissues to the maximum temperature possible for that current, and it is advisable to wait till the patient first feels warmth and feels that it is not increasing before increasing the current. There is more likelihood of procuring an even rise of temperature throughout the part if the current strength is increased very gradually, than if the rise to the maximum is made abruptly. There is more risk of burns with the latter procedure.

When there is anæsthesia there is always a risk of burns. If the patient

cannot perceive heat, and diathermy is thought indispensable, special care should be taken to see that the electrodes fit well, and the current density should never be allowed to exceed a known amount. Nagelschmidt has published the following tables showing the maximum strength which he thinks permissible for different size electrodes :—

Electrodes.	Strength of Current in Ampéres.
2 cm. diam.	0·15 — 0·2
4 cm. diam.	0·3 — 0·4
9 cm. diam.	0·9 — 1·0
4 by 6½ cm.	0·5 — 0·6
4½ by 10 cm.	0·6 — 0·7
5 by 12 cm.	0·9 — 1·0
10 by 20 cm.	about 2·0

The electrodes must be connected to the terminals 0 and 1 of the Siemens' diathermy machine.

Other Methods of Applying the Diathermy Current.—There are other ways of applying the diathermy current locally, and, in these, other effects are produced and the heating-through is subsidiary and less evident. In one of these the vacuum electrode is used. It is kept in contact with the skin and stroked over the region requiring treatment. The other (indifferent) electrode is a plain sheet of metal, and is placed on some convenient and remote part of the body. When the current is turned on and gradually increased the residual air in the glass electrode glows with a violet light. The skin quickly becomes hot and acquires a vivid erythema. Its glands are stimulated, and the glass of the electrode is gradually covered with their dried secretion. In this method of applying the current, the heat is chiefly in the epidermis, and it probably does not penetrate far. There is, however, stimulation of the skin, both by the very short fine sparks passing between the glass and the skin, and the ozone and oxides of nitrogen formed in the region of the sparks. After a short application of the vacuum electrode there is a strong odour of these gases. The latter are germicidal, and they may exert such an action in the superficial layers of the epidermis.

If a small sheet of metal be placed on the skin over the underlying muscles —an indifferent electrode having been placed elsewhere—and the cable from the diathermy machine placed, not directly in contact with it, but with a short air gap, the muscles will be strongly tetanised. The contraction is painless. The contraction becomes more powerful as the strength of the current and the width of the gap increase. The degree of diathermy is inappreciable, but the production of powerful contraction, without pain, may be of use in certain morbid conditions.

The Elevation of the Temperature of the Whole Body.—This may be brought about by use of the diathermy condenser couch. An alternative method is to direct the current along the limbs, from one leg to the other, and from one arm to the other, by way of electrodes placed in direct contact with the skin. In this way the tissues of the limbs are warmed directly. The blood, as it circulates through the limbs is at the same time warmed, so that, as it circulates

through the trunk and head and neck, these parts are also warmed. The electrodes should encircle the limb, and reach nearly from elbow to wrist or from knee to ankle. If they are placed on the palms or soles, the wrists or ankles, being the narrowest parts of the limbs, will be too strongly heated.

When Schittenhelm's pattern of condenser couch is used for general treatment, no electrodes need be placed *on* the body. The sheet of metal underlying the ebonite on which the patient lies is divided into four parts, one under each upper extremity and corresponding side of the trunk, and one under each lower extremity. The body is traversed by *induced* diathermy currents which surge in the body to and fro between any pair of extremities, depending on the connection of the underlying metal divisions with the terminals of the diathermy machine.

In diathermy condenser couches of this type, in which all the metal plates are placed *under* the insulating bed, it is doubtful whether the regions of the body that are not in contact with the bed are permeated by currents of any strength. Certainly the parts in contact with the bed feel the heat first and are always the hottest. Nagelschmidt devised a condenser couch in which the metal under the insulating bed is in one piece and connected to one terminal of the diathermy machine. The patient is completely covered (with the exception of the head) with a layer of insulating rubber, and upon this is placed a small-meshed metal net or sheet of aluminium, smaller in size than the rubber. This metal covering is connected with the other terminal of the diathermy apparatus. With this arrangement the patient would be more uniformly permeated by the current. This form of couch is described and illustrated in Nagelschmidt's *Lehrbuch der Diathermie*, pp. 45-46.

E. P. C.

(To be continued.)

REPORT OF SOCIETY.

THE MANCHESTER AND DISTRICT RADIUM INSTITUTE, THE ROYAL INFIRMARY, MANCHESTER.

A Report of the Work from Jan. 1st, 1915, to Dec. 31st, 1915.

Radiologist, ARTHUR BURROWS, M.D.
Physicist, HENRY LUPTON, B.Sc.

THE greater part of the energies of a new department working under complex conditions of interdependence with a number of different hospitals must, in its first year, be spent in organisation and getting the machinery into running order. The scheme, however, seems now to be fairly started, and the staffs of the constituent hospitals are doing their best to make the Institute a success.

Owing chiefly to the war there have been difficulties in obtaining certain parts of the necessary laboratory apparatus, but these difficulties have been mostly overcome, and the physicist is now able to make all the apparatus essential for his own and for medical purposes.

The internal alterations effected in the

building placed at the disposal of the Committee by the Board of Management of the Manchester Royal Infirmary have rendered the department convenient and compact. Owing to the necessity of obtaining the best natural light possible for the physical laboratory, it was necessary to make use of a somewhat small room having a north aspect. While adapted for all ordinary manipulations, it is felt that now that the routine has been fairly established a research laboratory suitably equipped might with great advantage be added to the Institute.

The greater portion of the medical work of the department has been the treatment of cancer in its various forms. This is quite natural when one considers the objects the founders of the Radium Fund had in view; but it is hoped that in the near future the treatment of a number of equally distressing, although not necessarily fatal, diseases will be undertaken by the Institute.

A report on one, or even two, year's work must, owing to the limited time which has elapsed, be an incomplete document, and all results recorded and experiences gained regarded with extreme reserve. The public are unfortunately prone to take an exaggerated view of what radium treatment is able to accomplish, and to raise up hopes which cannot at present be realised, but steady work and improvement in technique will undoubtedly tend to secure in the future a gradual improvement in the results at present obtained.

In the treatment of cancer the difficulties remain many and grievous, and until a sure method is devised of checking the formation of secondary deposits, it will be possible in but few cases to claim cures.

The investigations of the Middlesex Hospital Cancer Research Laboratories on carcinoma and sarcoma occurring in mice and rats have suggested the possibility of producing immunity to cancer by means of radium, but no method of application or refinement of dosage has as yet been devised which will produce this result with certainty in human malignant disease. In a few cases the sudden and almost unexpected disappearance of a tumour, or such signs of reaction as high temperature, rapid pulse, etc., have suggested the formation of antibodies; but this experience is uncommon, and for the present we must look more for local than for general effects from radium treatment.

The practice of the London Radium Institute of treating only inoperable cases of cancer has been followed. All cases of malignant disease, except rodent ulcer, should, in the first instance, go to the surgeon, and his opinion concerning the advisability or non-advisability of operation be accepted. Should he refuse to operate in a given case, treatment by means of radium or X rays should be considered. In certain border-line cases the use of radium may be advantageously combined with operation. One of the cases of carcinoma of the tongue, classified in Table I. under "Prophylaxis," is an example of the value of this method. When the tongue had been removed tubes of "emanation" were inserted into suspicious situations. The patient is still well six months after operation. One case of sarcoma of muscle was also successfully dealt with by this method.

The department has carried on the treatment of tumours by embedding tubes of radium and radium emanation on a larger scale than has, it is believed, been customary heretofore in this country. In the case of large and deep-seated tumours, the results obtained by embedding are, as a whole, better than those obtained by the application of superficial flat plates. In a number of cases, recorded in Table II. as "improved," the primary growth has entirely disappeared. Thus, much pain and suffering have been saved, although secondary deposits, many of which have in their turn been diminished in size or have disappeared, have prevented the attainment of the result desired. The case of carcinoma of the colon, which remains well at the end of this year, is a good example of the value of this particular method.

Small tubes of emanation and occasionally of radium—the former has many mechanical advantages—are employed for implantation. They are contained in cylindrical metal screens or filters, to which silk threads are attached. The screens commonly employed are:—

1. Tubes of silver, the walls of which are 1 mm. thick.

2. Small tubes of platinum, the walls of which are $\frac{3}{10}$ mm. thick. These are pointed,

and are of the type first devised and used at the London Radium Institute.

3. Stevenson and Jolly's needles: these are of the bore of small serum syringe needles. They are made of steel, and their walls are three-tenths or four-tenths of a millimetre thick. Originally they were left open at the ends and small emanation tubes fixed in them by allowing heated paraffin wax to run into their lumen by capillary action, where it solidified as it cooled.

A modification of the needle has been more generally used in the department. Messrs. J. Woolley, Sons & Co., of Manchester, were able to make, according to instructions, a needle, the pointed end of which is solid, and which can be screwed on or off, while the solid eyeleted end can also be dealt with in the same manner. The emanation tube can be introduced into the central cylindrical portion of the needle, while the screwed-in ends obviate the use of wax. In the same easy manner the emanation tube may be removed, and cleansing and boiling thoroughly carried out. Emanation tubes are made in lengths to fit the cavities, and there is no need to localise them once they are in the needle. In other respects the needle is identical with Stevenson's.

One or two other types of screen are occasionally used.

All doses of radium are expressed in terms of radium element, and the equivalent of emanation in "millicuries." This seems to be a more rational method than employing the commercial standard of radium bromide, with its water of crystallisation included, as the radium is the source of the rays, and these rays are the agents employed in the usual method of measurement, viz., by means of the electroscope. The presence of other elements in combination thus becomes, except in a limited sense, a matter of no importance.

The following observations were made during the year with regard to the general facts to be borne in mind when burying tubes in growths, or when deciding if a case is or is not suitable for the same:—

(*a*) Thorough aseptic technique is as necessary as in general surgery, because screened radium does not have a markedly antiseptic effect.

(*b*) Screens containing tubes of radium emanation may be boiled since the internal pressure of the heated tubes is, as a rule, well below that of the atmosphere. The boiling of tubes containing radium salts is not worth while on account of the risk of breakage.

(*c*) The object in radium treatment is to produce an adequate and even distribution of the rays throughout a tumour. Thus, it is usually better to bury a number of weaker tubes in a growth than to employ one strong one for the same purpose.

(*d*) Accurate implacement of a tube in a growth is essential. It usually happens, therefore, that it is better to make a large incision and expose a tumour than to push tubes blindly through a small cut in the skin. It is, moreover, safer.

(*e*) It may be ignorance, but it has rarely so far been found possible to remove a cancer with one dose. This is a drawback which time may cure. At present, however, too big a dose may produce too violent a reaction, with local necrosis of tissue.

(*f*) The reaction, or ulceration, after an overdose may last a long time, but never fails to settle down or to heal completely in the long run, with the following exception, as noted in *g*.

(*g*) A growth treated by radium must be surrounded by or contain an adequate quantity of healthy tissue capable of supplying sufficient assistance for the work of repair, otherwise a permanent malignant ulcer may be formed. For example, the surface of the sternum or of a rib is a common site of recurrence after operation for removal of carcinoma of the breast. The nodule lies between the sternum and the stretched but impoverished skin. If it be treated by burying a tube of radium or emanation in its substance, it will be difficult to give a dose sufficiently strong to be effective. If it be large enough the nodule will probably break down and form an intractable progressive malignant ulcer. A similar dose administered to a superficial nodule in more healthy surroundings may produce no ulceration at all, or, if it does, rapid healing will take place. It is better to attempt to treat recurrences situated in regions of low vitality by means of externally applied radio-active plates.

(*h*) The quantities of radium and radium emanation which should be used vary, according to the size of the growth, the thickness of the screen employed, and the situation of the tumour. Some malignant growths appear to need larger doses per cubic centimetre than others; but to give a larger dose per volume in a case of, say, carcinoma of the tongue than is quite sufficient for a lymphosarcoma, is to take the risk of forming a slough of unpleasantly large dimensions.

When screens of 1 mm. of silver or three-tenths millimetres of platinum, containing 20 to 50 millicuries of emanation, are used, the usual exposure of twenty-four hours seems most often the best. Other and much shorter times have been suggested but do not seem to be so effective, at least in their local effects.

If Stevenson's needles be employed they should never contain more than 5 mc. of emanation, preferably 2-3, and should not be left in position more than twelve hours. One case of sarcoma of the upper jaw has been treated by these needles very effectively, with exposures of twenty-four hours without signs of overdose, but this is an exception to general experience.

It usually seems, although conditions are so diverse that it is difficult to judge, that if a dose be doubled less than half the previous exposure will be needed to produce the same effect.

Speaking generally, tubes of 25 mcs. contained in screens of silver 1 mm. thick, or platinum $\frac{3}{10}$ mm. thick, placed in a growth 2-3 cm. apart for twenty-four hours has been the most usual treatment given at the department, but it is obvious that every additional tube buried in a tumour must increase the total radiation traversing any given point in the mass, so that the aggregate dosage must always be considered. If we could find out exactly the amount of radiation therapeutically needed per cc. of a tumour, and an accurate method of estimating the size of cancer growths, there would merely be left to the physicist a mathematical calculation of the quantities to be used to produce total absorption, and the use of a sufficient number of tubes would remove the possibility of local overdose.

(*i*) In the treatment of malignant glands of the neck by means of radium, careful attention should be given to the toilet of the mouth. The presence of ulceration or of carious teeth may lead to septic infection of neighbouring glands which, in combination with enlargement of other glands, the result of the existing malignancy, may produce on the introduction of a radium tube definite abscess formation.

The majority of the cases treated during the year have been cases of rodent ulcer, and of carcinoma of the breast, uterus, rectum, and mouth.

The treatment of rodent ulcer continues to yield excellent results. Short, unscreened exposures (1-3 hours) of strong plates of radium are still the best method of dealing with them. In fact, falling back on the use of metal screens with longer applications is usually a sign of failure; although such a treatment applied at the beginning may be as successful as the unscreened method. Moreover, it is unnecessary and less economical. Stevenson's needles are of material assistance, however, in clearing up certain ulcers with greatly thickened edges and deep induration. In fact, many cases which would otherwise have been regarded as hopeless have yielded perfect results following "needle" treatment.

To carcinoma of the breast practically the whole of the general remarks of this report apply. In a number of cases the primary growth has been removed by radium, and individual secondary deposits dealt with in the same way. Thus many of the painful and unpleasant features of the disease have been diminished, but usually a distant metastasis has in the end placed the patient beyond hope. If the growth be extremely large and widespread, the same state of inability to repair is produced as in the case of a nodule formed in an unfavourable position.

The treatment of carcinoma of the cervix of the uterus has, on the whole, given good results. In dealing with such cases it has been customary to give a general anæsthetic. In this way a tube of 50 mcs. of emanation contained in a screen of 1 mm. of silver may be placed accurately in the cervical canal. Usually its action is reinforced by inserting emanation needles in distant infected regions, or in thick masses of the growth. Three or four small platinum tubes pushed into the

substance of the cervix will produce an equally good result, but the method is not so economical. Fungating growths of the cervix yield most readily to treatment, while deep excavating ulcers with thick edges are less satisfactory. Invasion of the vaginal canal is an adverse sign. Four cases remain apparently quite well at the end of the year, and many more have had remarkable relief or complete absence of symptoms for six months or more.

Carcinoma of the rectum, owing to its situation, can only be treated by passing tubes of radium into the lumen of the growth. The presence of sensitive mucous membrane makes the use of a dense or thick screen (1.5 to 2 mm. of lead covered by rubber to cut off secondary rays) essential. For the most part the relief of symptoms is all that can be looked for. In one case in which the growth was unilateral a tube was introduced into the rectum and placed against its inner aspect, while another was pushed up through the perineum to the other side of the mass. In this way a cross-fire effect was produced. Unfortunately, the patient did not submit to further examination, and no observation could be made.

Carcinoma of the mouth and tongue still gives unfavourable results, but one or two cases have done remarkably well. The only method of treatment which gives the slightest hope of success is implantation of tubes; external applications are practically useless. At present it is undecided if emanation needles with steel walls of $\frac{3}{10}$ mm. thickness introduced into the growth for about twelve hours give better results than large doses of 30-40 mc. of emanation contained in pointed cylinders of platinum the walls of which are five-tenths mm. thick. If tubes of platinum three-tenths mm. thick are used, 15 mc. of emanation is quite a large enough dose.

TABLE I.

Classified Results.

Free of disease at end of year	45
Improved	187
Not improved	123
Abandoned treatment	43
Died from their disease	61
Too early to note result	51
Prophylaxis	9
Total	519

TABLE II.

Classification of Cases.

Disease	Too early to note result	Not improved	Improved	Free of Disease at end of year	Died from their disease	Abandoned treatment	Total
CARCINOMATA:							
Anus ...	—	—	—	—	1	—	1
Breast ...	8	22	34	—	9	7	80
Bladder ...	—	—	—	1	1	—	2
Cervix uteri ...	3	9	22	4	2	6	46
Colon ...	—	—	—	1	1	—	2
Ear ...	—	2	3	—	—	1	6
Glands ...	2	3	2	—	—	1	8
Jaw (upper) ...	1	1	2	—	1	—	5
Jaw (lower) ...	—	1	—	—	—	—	1
Larynx ...	—	—	—	1	2	—	3
Lip ...	1	—	2	—	—	1	4
Mouth-pharynx ...	4	17	12	—	4	1	38
Tongue ...	1	11	4	1	5	2	24
Tonsil ...	2	1	—	1	1	2	7
Naso-pharynx ...	1	—	1	—	1	—	3
Œsophagus...	—	1	—	—	4	1	6
Orbit ...	—	1	1	—	—	—	2
Ovary ...	—	2	—	1	—	2	5
Paget's disease ...	—	—	1	—	1	—	2
Parotid and sub-maxillary glands ...	—	—	4	—	—	—	4
Penis ...	—	—	—	—	1	—	1
Perineum ...	—	—	—	—	1	1	2
Rectum ...	3	5	8	—	4	1	21
Scrotum ...	—	—	1	—	1	—	2
Skin (nose, ear, face, etc.) ...	3	7	4	4	—	2	20
Spine ...	—	—	2	—	1	—	3
Stomach ...	—	1	2	—	—	—	3
Thyroid gland ...	1	3	3	1	—	2	10
Vulva and vagina ...	—	4	1	—	1	—	6
Prophylaxis ...	6	—	—	—	—	—	6
Total ...	36	91	109	15	42	30	323
SARCOMATA:							
Glands ...	4	—	2	—	—	1	7
Jaw (upper) ...	1	—	1	—	1	—	3
Long bones...	—	—	1	—	—	—	1
Muscle ...	—	—	2	*1	—	2	5
Naso-pharynx ...	—	—	—	1	1	—	2
Orbit (bony) ...	—	1	—	—	—	—	1
Palate ...	—	—	—	—	1	—	1
Periosteal ...	—	1	—	—	—	—	1
Popliteal ...	1	—	—	—	—	—	1
Pleura ...	—	—	1	—	1	—	2
Retro-peritoneal ...	—	—	—	—	—	—	—
Ribs ...	—	1	1	—	—	—	2
Supra-renal ...	—	—	—	—	1	—	1
Testis ...	—	—	—	—	—	1	1
Tonsil ...	—	—	1	—	—	—	1
Prophylaxis ...	2	—	—	—	—	—	2
Total ...	8	3	9	2	5	4	31
RODENT ULCER ...	8	12	26	24	1	2	73
MALIGNANT TUMOURS (various):							
Endothelioma ...	1	—	3	—	3	—	7
Malignant glands ...	—	1	4	—	3	4	12
Lymphosarcoma ...	—	2	—	—	3	—	5
Melanotic sarcoma ...	—	—	—	—	—	—	—
Mediastinal tumour ...	—	—	1	—	1	—	2
Prophylaxis ...	1	—	—	—	—	—	1
Total ...	2	3	8	—	10	4	27
BENIGN TUMOURS:							
Fibroid uterus ...	—	—	1	—	—	—	1
Fibroma of hand ...	—	—	1	—	—	—	1
Fibro-adenoma of parotid gland ...	—	1	—	—	—	—	1
Certain tumours of doubtful nature ...	2	—	—	—	—	1	3
Papilloma of Bladder ...	—	1	—	1	—	—	2
Glioma of orbit ...	—	—	—	—	1	—	1
Myeloid sarcoma...	—	—	2	—	—	1	3
Papilloma, hard palate ...	—	1	—	—	—	—	1
Myxoma ...	—	1	—	—	—	—	1
Kraurosis vulvæ et vaginæ ..	—	—	1	—	—	—	1
Capillary nævi ...	1	—	2	—	—	—	3
Cavernous nævi ...	—	—	3	—	—	—	3
Circoid aneurysm ...	—	—	1	—	—	—	1
Total ...	3	4	11	1	1	2	22

Disease	Too early to note result	Not improved	Improved	Free of Disease at end of year	Died from their disease	Abandoned treatment	Total
GENERAL & SKIN DISEASES, CHRONIC INFLAMMATION:							
Arthritis deformans	—	2	—	—	—	—	2
Exophthalmic goitre	—	—	7	—	—	—	7
Eczema (chronic)	—	—	1	—	—	—	1
Granulomata of skin	—	—	—	1	—	—	1
Hodgkin's disease	1	—	3	—	1	—	5
Keloid and vicious cicatrix ...	—	—	5	—	—	—	5
Lymphatic leukæmia	—	1	—	—	—	—	1
Lymphangitis	—	—	1	—	—	—	1
Lupus vulgaris	—	1	—	—	—	—	1
Lupus erythematosus	—	—	—	—	—	1	1
Mastitis (chronic)	—	1	—	—	—	—	1
Metritis (chronic)	—	1	—	—	—	—	1
Macroglossia	—	1	—	—	—	—	1
Mucous colitis	—	1	—	—	—	—	1
Myositis (chronic)	—	—	1	1	—	—	2
Myeloid leukæmia (acute) ...	—	—	—	—	1	—	1
Oto-sclerosis	—	—	1	—	—	—	1
Pruritus	—	1	—	1	—	—	2
Pigmented mole	—	—	1	—	—	—	1
Spring catarrh	—	—	2	—	—	—	2
Sinus (chronic suppurating) ...	1	—	—	—	—	—	1
Tuberculous glands	1	1	—	—	—	—	2
Uterine hæmorrhage	—	—	2	—	—	—	2
Total	3	10	24	3	2	1	43

Combined with operation.

The number of patients registered up to 31st December, 1915, was 655, of whom 104 were private patients, 620 have been seen by the radiologist, 519 have received treatment, 93 have been found unsuitable, 35 have not attended after registration, and 8 have been placed on the waiting list. The total number of attendances during the year was 2,670.

REVIEWS.

Localization by X Rays and Stereoscopy. By Sir JAMES MACKENZIE DAVIDSON. 70 pages. A large number of diagrams and illustrations. Price 7s. 6d. net. H. K. Lewis and Co., Ltd., London.

The case for stereoscopic radiography, especially from the point of view of the accurate localization of foreign bodies, is forcibly set out in this publication. Coming, as it does, when practically the whole world is acutely interested in this subject, it is a valuable addition to our knowledge. The author is more than a recognised authority on the value and technique of steroscopic radiography, he is the parent of the method, and this must of itself enhance the value of this book. Starting with a short introduction on the X-ray tube, there are some interesting remarks as to the focus of tubes, and a series of instructive photographs showing the difference between properly and badly focussing of the cathode stream. A chapter on secondary rays and X-ray protection, also illustrated with suggestive illustrations, is not out of place when so much of the war work is being done by non-expert radiographers entirely uneducated as to the risks of X-ray work. Great stress is laid upon the danger from the rays which are given off from all parts of the glass surface of tubes, these, in the author's opinion, being not only the cause of plate fogging, but also of serious danger to the operator. In introducing the actual method of stereoscopy an important point is made of "The Misleading Single Picture." This point is of such paramount importance that we regret that even more was not made of it. The reviewer knows of many glaring examples of bad surgery—in this war—where attempts to find foreign bodies, based on a single radiograph, have ended in ghastly failure. The combination of a mere X-ray photographer with a surgeon who believes he can interpret radiographs, and really knows nothing about it, has proved disastrous in too many cases. The cross-thread method—Davidson's original idea—is fully explained, and the concluding chapter on foreign bodies in the eye proves to the hilt the extreme accuracy which is possible in even this difficult branch of localization. There is a chapter

on the Telephone Probe as an aid to the finding of, and removal of, certain metallic foreign bodies; this was also brought to the notice of the profession by the author, and he has done much to perfect the instruments required. A new couch and screen localizer, designed more especially for rapid work in the field, is a distinct advance. For war work the simplicity of design of this table should make it invaluable. The book as a whole is very readable, is beautifully illustrated, and should be read by all surgeons doing war work. The expert in radiography will also find it a useful addition to his library.

C. THURSTAN HOLLAND.

Stereoroentgenography of the Alimentary Tract. By JAMES T. CASE, M.D. *Section* xxxiv. *of the Stereoclinic.* Edited by Dr. HOWARD A. KELLY, Baltimore, M.D. The Southworth Company, Publishers, Troy, N.Y.

The work of Dr. Case is too well known to require any introduction, it is sufficient to state that he has excelled any previous publications by the uniform excellence of what must be regarded as his masterpiece.

It would be difficult to imagine anything more complete than the four volumes of text and illustrations which make up this work. The latter are high class productions of the radiographic art, the text is characterised by a wise restraint, and gives evidence of a thorough clinical knowledge of the diseases of the alimentary system, the interpretation being always logical and sound, while debatable points are fully discussed.

The interpretation of the X-ray findings shows the expert in every line.

For a long time to come this will remain the reference work of this subject for all radiologists, physicians, and surgeons. The practising radiologist will find in its pages much information of the greatest possible value to him in his daily work.

The physician and surgeon will be helped in the interpretation of radiographic findings and their bearing upon the diseases of the alimentary system.

Dr. Case has brought forward a most convincing argument in favour of stereoscopic work in the examination of the alimentary system, and as the book finds its way into the hands of the majority of radiologists, it is hoped that a stimulus will be felt and result in the universal practice of stereoscopic methods in alimentary work.

The introductory chapter gives a full description of the technique employed by Dr. Case. The description of the method of arranging apparatus, of making the exposures, and the time occupied in the two exposures is of value. We note with satisfaction that Dr. Case is an advocate for the use of the combined method—*i.e.*, the fluoroscopic and the radiographic.

He particularly states that the plate method alone in so far at least as it relates to the gastro-intestinal tract is insufficient. The ideal method is the combined one, the observer employing both roentgenography and roentgenoscopy, the plate record serving to confirm the findings of the screen examination.

The Coolidge tube is described and spoken of very favourably in the taking of radiographs, offering, as it does, special facilities for good work.

The diseases of the œsophagus are fully described and illustrated, several beautiful pictures being shown; the chapter is illustrated in the text by a number of descriptive diagrams.

The description of the normal stomach is interesting, and many practical points are given; the conception of the form of the peristaltic wave of the stomach is strengthened by diagrams after Rieder of "composite tracings" from twelve pictures taken in rapid succession. This shows well the passage of the wave along the stomach walls.

An important point is shown in stereo 15, taken with the patient lying prone, the plate on the anterior abdominal wall. The plates were exposed during a deep inspiration, the two exposures taking less than a second. The appearance presented is very different to that shown with the patient in the upright position. It is important to bear this difference in mind when examining plates taken with the patient prone.

Duodenal ulcer is briefly described and illustrated by a number of stereos. The points made in the diagnosis of duodenal ulcer are (1) Deformity of the duodenal bulb

persisting at all examinations; (2) Increased depth of peristaltic wave; (3) Delayed emptying of the stomach.

Hypertonicity of the Stomach.—In the illustrations of this condition an interesting point is well shown, namely, the rotation of the stomach forwards and upwards, a condition which Dr. Case states frequently accompanies zonal ulcer with adhesions. The author opens up a useful field for future investigation in this condition, and its relationship to adhesions in the region of the gall bladder, duodenal and pyloric ulcers, and particularly in regard to delay in the emptying time of the stomach in cases where adhesions round the gall bladder may be the only pathological lesion present.

Pyloric ulcer and perforating pyloric ulcer are next described.

Tuberculous Ulcer of the Stomach.—This condition is not often met with, and probably is rarely diagnosed; the radiographic appearance is shown in stereo 23, where a filling defect on the greater curvature gave a clue to the diagnosis. The differential point in diagnosis between this and carcinoma would be interesting; doubtless it rested largely on the clinical history and the age of the patient. It would have been still more interesting to have the after history of this case.

Ulcer of the stomach is fully dealt with in Volume II, as is also the important subject of malignant disease; the latter is very fully entered into, and many extremely useful plates are shown.

Volume III contains twenty-five stereoscopic pictures, the first ten of which illustrate morbid conditions of the small intestine, such as acute and chronic obstruction, ileal stasis, and ileocæcal valve incompetence; the latter is most fully described and illustrated by typical cases.

The remaining fifteen plates illustrate diseases of the cæcum and ascending colon, cases of Jackson's membrane, carcinoma, retrocæcal appendix, and an interesting case of a portion of a hæmostat in the peritoneal cavity.

Volume IV concludes the publication, and is composed of many atypical abdominal conditions, post operative studies, and aberrant sigmoids.

The scope of the book is most comprehensive and full of illustrations of great educational value. The practising physician or radiologist who carefully studies the plates cannot fail to improve his knowledge of morbid conditions, and the perusal of the text will in many ways increase his practical knowledge, where also it may confirm many ideas of his own.

The greatest praise must be given to the publishers for the excellent format of the work; the text is particularly clear, the general arrangement is of the best, and the illustrations are worthy of the highest commendation. The book is a remarkable one, and is bound to achieve a great and lasting success.

NEW INSTRUMENT.

SWEET'S IMPROVED EYE LOCALIZER.

This consists of a mechanical elaboration of the well known eye localizer of the same name, and it is claimed that the improvements have largely eliminated the human element of error.

The new apparatus (Fig. 1) consists of an adjustable head rest, to which is attached a hinged and sliding frame. This frame carries the tube holder, the indicator, which is a small lead ball supported in a ring of transparent glass, a mirror, a telescope, and the plate holder, so that they maintain a constant relation to each other.

The telescope (Fig. 2) contains in its interior a cross wire and a small reflecting mirror, and is adjusted by a screw. On looking down the eye-piece, one adjusts the telescope until the reflecting mirror shows the cross wire to be

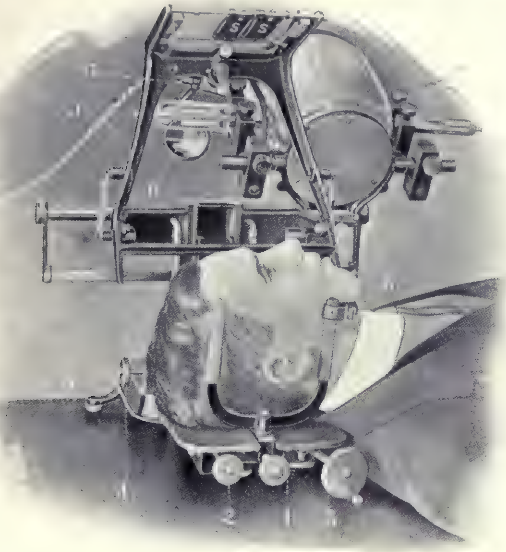

FIG. 1.—SWEET'S EYE LOCALIZER. Patient in position, awaiting adjustment of apparatus, with the upper jointed portion turned back. 1 Wheel controlling head clamps. 2 Wheel controlling lateral movement of platform on which head rests. 3 Wheel controlling vertical movement of entire optical system. 4 Wheel controlling longitudinal adjustment of platform on which head rests. 6 Strap maintaining chin in fixed position. G Indicating Ball of Lead. H Mirror. J Frame supporting entire optical system. S Shutters.

exactly tangent to the summit of the cornea; the metal indicator will then be 10 mm. from the centre of the cornea of the eye under examination. A small incandescent lamp is attached so that the adjustment may be more readily read. The position of the indicator is further verified by means of a small hole in the overhead mirror (Fig. 3). By an ingenious device, when the patient looks at the reflection of the indicator in the mirror above with his uninjured eye, the optical axis of his injured one is brought parallel to the plate (Fig. 3).

The X-ray tube is centred by means of markings on its lead glass shield, and the first exposure is made on part of the plate, the rest of which is protected by a metal shutter (Fig. 2). A metal shutter is now placed over the exposed portion, and the tube, carrying with it the indicator and the plate, is moved a definite distance towards the patient's feet and the second exposure at once made on the previously protected portion of the plate.

Efficient protection to the operator and patient is claimed by the lead glass tube shield, the lead diaphragm, and a sheet of aluminium in its aperture.

After development, the plate is superimposed on a special key plate, and the co-ordinates of the two shadows of the foreign body in the two exposures read off. These readings are then transferred to a localization chart (Fig. 4), where the position and depth of the foreign body in the eyeball or orbit is shown.

Compared with the previous localizer, the differences are entirely mechanical. They are:—

The adjustable head rest with the sliding frame carrying the tube, etc.

The more accurate and convenient method of placing the single indicator at the fixed distance from the centre of the cornea.

The device for bringing the optical axis of the injured eye parallel to the plate.

The protection, rapidity, and ease

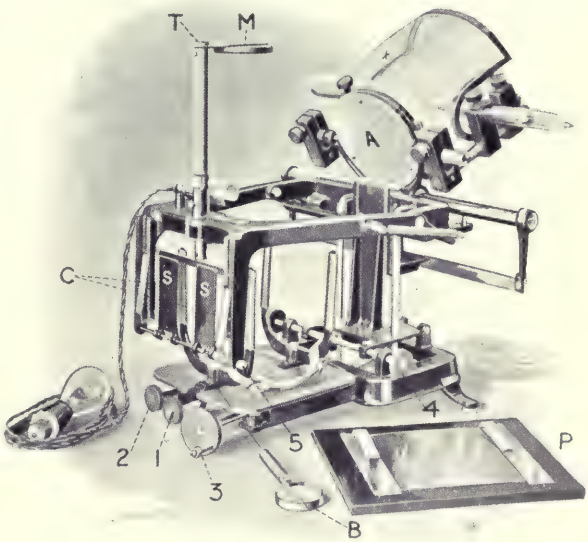

FIG. 2.—The apparatus in position for taking the first radiogram. 1 Wheel controlling head clamps. 2 Wheel controlling lateral movement of platform on which head rests. 3 Wheel controlling vertical movement of entire optical system. 4 Wheel controlling longitudinal adjustment of entire system relative to the eye. 5 Strap maintaining chin in fixed position. S Shutters. P Key plate. A Aluminium screen. T Eyepiece in Telescope. M Mirror. C Plate holder clips. B Reading glass for minute examination of chart.

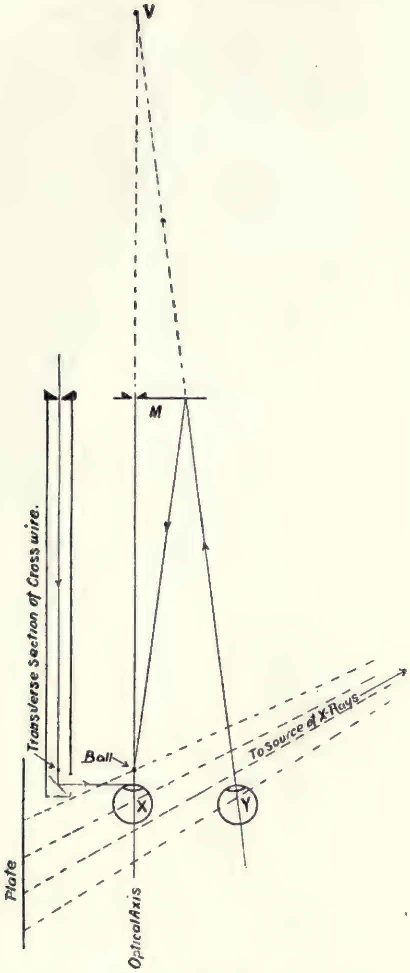

FIG. 3. – Diagram of the Optical System. V Vertical image of Ball as seen by uninjured eye. M Mirror. X Injured Eye. Y Uninjured Eye.

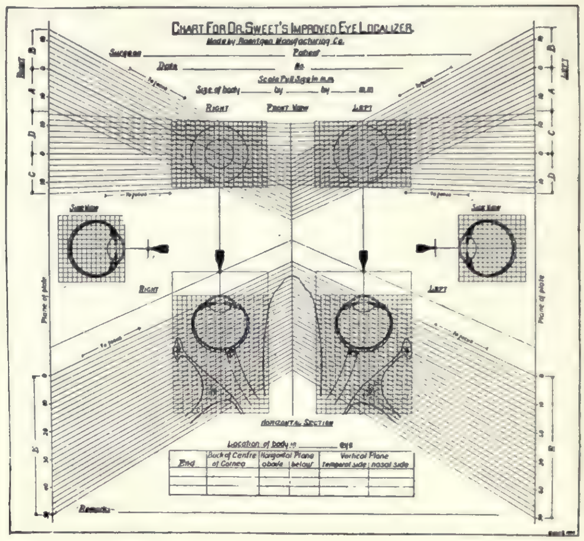

FIG. 4.—Reduced facsimile of localisation chart.

with which the two exposures can be made on the same plate.

And, finally, in the interpretation, no lines have to be drawn on the negative, which is simply superimposed on the key plate and the co-ordinates noted and transferred to the chart, where the localization has been mapped out mathematically. The instrument is made by the Snook Roentgen Manufacturing Co.

R. W. A. S.

NOTES AND ABSTRACTS.

RADIOGRAPHY.

Thorium : A New Agent for Pyelography. Bulletin of the Johns Hopkins Hospital, June, 1916, page 157 (preliminary report in the *Journal American Medical Association*, Vol. XIV., p. 2126). By J. EDWARD BURNS, M.D. —Collargol is dangerous: injury to kidney, and death of patients have followed its use.

It is very expensive. It stains everything. Its elimination from the urinary tract is prolonged owing to its viscosity.

The paper then discusses the salts of thorium—some are irritating.

Nitrate of thorium up to 50 per cent. strength is valuable for pathological work, and after injection specimens can be fixed in Kaiserling's solution, which precipitates thorium salts.

A safe solution for clinical work: — To make 100cc. of a 10 per cent. solution, 10gm. of thorium nitrate are dissolved in as little distilled water as possible. To this solution—kept hot on a water or steam bath

—are added 30cc. of a 50 per cent. solution of sodium citrate. Make the additions in small quantities, and shake thoroughly after each addition. (At first, after the addition of the citrate solution, a white gummy precipitate is formed, which later becomes granular, and finally dissolves on the addition of all the citrate solution.)

The solution is then made neutral to litmus by the careful addition of a normal solution of sodium hydroxide, and made up to the required volume of 100cc. with distilled water.

On filtration a clear, limpid solution is obtained, which, when sterilized, either by boiling or steam under pressure, is ready for use.

This solution contains approximately 15 per cent. of thorium nitrate, about 9 per cent. of sodium nitrate, and 21 per cent. of sodium citrate, the thorium being most probably in the form of a double citrate of sodium and thorium. The thorium content alone casts the shadow.

The gravity method should be used for its introduction into the kidneys and ureters.

The paper then deals fully with the pharmacological action of the solution, and details the results of experimental work on animals. Many beautiful radiographs illustrate the kind of cases in which it has been used, and fully demonstrate that it is satisfactory from the X-ray point of view.

Clinically its use in 125 cases, in quantities from a few cubic centimetres to almost a litre, has proved its non-toxicity. It has been quite non-irritating. The solution is clear and watery, and is thus readily eliminated. It is clean, and does not stain linen. It is quite inexpensive, being about one-third as costly as collargol. C. T. H.

CORRESPONDENCE.

To the Editors of Archives of Radiology and Electrotherapy.

Sirs,—In a discussion at the Röntgen Society, reported in the June number of the Archives, p. 34, I note that a serious error has crept into some statements of mine with regard to Captain Stone's experiments. As the matter is an important one I have written to Captain Stone, who has sent me the following record of the experiments. It must be remembered that, as the pastille is at full instead of half distance, $\frac{1}{4}$ B tint represents a full dose, and a further allowance must be made for the pastille turning back when not exposed to light.

Duration of Test.	Position of Pastille.	Degree of Pastille turned.
1 month	Front of Apron	nil.
3 ,,	,, ,,	$\frac{1}{16}$th to $\frac{1}{8}$th B tint.
6 ,,	,, ,,	$\frac{1}{8}$th to $\frac{1}{4}$th B tint.
1 ,,	Inside ,,	nil.
3 ,,	,, ,,	nil.
6 ,,	,, ,,	very slightly.
6 ,,	Inside gauntlet	nil.

I am, yours faithfully,
N. S. Finzi.

107, Harley Street, W.
27th June, 1916.

ROYAL MEDICAL BENEVOLENT FUND.

To the Editors of Archives of Radiology and Electrotherapy.

Dear Sirs,—The Royal Medical Benevolent Fund, the great benevolent society of the medical profession, is sorely in want of money now.

Though in ordinary times the medical profession supports its own poor, in these war times this is no longer possible. At the May meeting the Committee had a balance of only £17 in hand, and at the June meeting was faced with a deficit of £16. The demands were heavy and had to be met, and this could only be done by withdrawing £500 from the bank.

As the direct outcome of the war, not only are the ordinary cases of poverty greatly increased in number, but an entirely new class of case has arisen urgently requiring relief, in which without actual poverty there is great temporary distress—distress, however, which it is hoped will relieve itself soon after the war is over and the doctors serving return to their civil duties.

At the outbreak of war the medical profession responded freely to the Nation's call. The Territorial Medical Officers were at once called out and other medical men volunteered. Both alike had to leave their practice at very short notice, and often without being able to make adequate provision for its continuance and maintenance during their absence. Their pay went but little way to supply the loss which their absence entailed, for the working expenses of the practice could not be materially reduced. The result was that many families found themselves in very straitened circumstances. Rent, rates, and insurance brook no delay, but worst of all school bills could not be paid, and if help had not been quickly forthcoming the children would have suffered for the patriotism of their father.

The following are typical of the cases with which our Fund has had to deal:—

A young doctor, who had only been in practice a few years, volunteered for service, and was killed in action a few days later. He left a widow, aged 35, with two young boys, aged 3½ and one year, entirely without means. The Fund voted £25 for her immediate necessities, and put her into communication with the Officers Families Association, which gave further help.

A practitioner, aged 38, earning £700 to £800, volunteered for service, leaving his practice in the hands of a neighbour who was not a success. There were two young children, and another baby was born shortly after the husband left. The wife contracted pneumonia and nearly died. A resident patient had to leave the house. Rent and other expenses led to a debt of about £80. This the doctor could not meet, and he hurried back from the trenches to save his home from being sold up. The Fund voted £25, the Guild gave £15, the Officers Families Association £25, and the Professional Classes War Relief Council further help, with the result that he returned to the front with his immediate anxieties relieved.

A captain in the Territorials was called out and had to leave his practice in the hands of a locum, who proved a failure. There were seven children, aged 2 to 14. Financial difficulties arose and payment of the school fees became impossible. Between the Fund and Guild, and Officers Families Association, the necessary fees were raised, and clothing, which was greatly required, provided.

These cases show well the way in which the Fund works, not only by giving relief itself in money and kind, but also by obtaining, through co-operation with other benevolent societies, more substantial assistance than it could afford alone.

But there is another class in which the distress is, perhaps, even greater and adequate relief more difficult. It is that of men who left home and a good practice, in vigorous health, and who have come back crippled by wounds or with health impaired, to a practice severely damaged by their absence, and without the strength or energy to regain the practice and position which they sacrificed.

Our Fund has set apart a special sum to meet emergency claims of this kind, yet the demands are so great that it will soon be exhausted. We cannot now rely on the profession alone to supplement it largely, for the medical profession, like all other professions, is hit very hard by the war, and has no longer its old resources to draw upon.

What is required is an Emergency Fund large enough to deal adequately with these emergency cases arising directly out of the war, and for this we are driven to appeal to the public as well as to our own profession.

We trust that our appeal will meet with a liberal response both from the public and from the medical profession, for, unless fresh funds are quickly forthcoming, it will be impossible to continue the relief which is so urgently required.

We are, faithfully yours,

John Tweedy, *President.*
Samuel West, *Hon. Treas.*
C. Newton Pitt, *Hon. Sec.*

11, Chandos Street,
Cavendish Square, London, W.
3rd July, 1916.

Communications relating to advertisements should be addressed to the Publisher, Mr. William Heinemann, 20 and 21, Bedford Street, London, W.C., Telegraphic Address: "Sunlocks, London"; Telephone: No. 5675 Gerrard, and (American) Messrs. Rebman Company, 141-145, West Thirty-sixth Street, New York City.

Annual Subscriptions, payable in advance, to members of recognised medical and scientific societies, 16/-, to non-members, 21/- ($5.00 Postal Union), including postage. Single copies 2/- (postage 2d.) Single numbers and back numbers can be supplied on application.

Vol. XXI—No. 4 SEPTEMBER, 1916 No. 194

ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

TEACHING OF ELECTROTHERAPEUTICS AT GLASGOW.

The announcement in the *British Medical Journal* for July 15th, 1916, that the Merchants' House of Glasgow has offered to provide funds from the Buchanan and Ewing bequests for the payment of University lecturers in electrical therapeutics at the Royal and Western Infirmaries, will be read with pleasure by all who are interested in Electrotherapeutics.

It is to be hoped that the University of Glasgow will rise to the occasion and supplement these lectureships in kind, which will enable the University to inaugurate a Chair dealing with Radiology and Electrotherapeutics.

The fortunes of the Glasgow University have through all times been intimately linked up with the commercial success of Glasgow, the city fathers of the past early grasped the significance of having a progressive educational institute in their midst. Much of the success of Glasgow men has originated from the sound learning inculcated at the ancient University. As the city developed in material things the welfare of the University was not over-

looked, so that at the present time Glasgow University holds an honoured position in the nation's centres of learning.

The Merchants' House of Glasgow is provided with funds which may be devoted to the advancement of education, and the governing body shows its characteristic progressive spirit when it offers to provide funds for the payment of University lectureships in Electrotherapeutics at the Royal and Western Infirmaries.

We take this opportunity of congratulating the University of Glasgow on the proposed establishment of lectureships on these subjects, and at the same time would humbly indicate a further step which would inevitably reflect credit on the discretion of the Senate in later days. The time is ripe for the foundation of a Chair in Radiology and Electrotherapeutics. This would embrace the whole of the work covered by these subjects. All that is wanted is a central institute where the work could be correlated and systematically studied. The Radium Institute at present in existence in Glasgow could be incorporated and the clinical teaching could be carried on at the Royal Infirmary and Western Infirmary.

Radiology being so intimately associated with physics, the work covered by the two chairs could be to some extent correlated, and an advanced course of physics could be arranged for those students who are taking up the study of radiations for therapeutic or industrial purposes.

Tentative proposals are being made to other educational bodies with a view to the establishment of such chairs and lectureships. The University which takes the lead in these matters will ultimately draw largely upon the students who are contemplating the study of the fascinating subjects which are the fundamentals of Radiology.

PREFACE TO ARTICLE ON RENAL CALCULI.

By Ferguson Lemon, M.B., B.S., Melbourne.

ACCURACY IN SKIAGRAPHY.

In an article appearing in a recent issue of the Archives of Radiology and Electrotherapy it was strenuously pointed out by the Editors that the time had arrived when Radiology and Electrotherapy in all its branches should be given a distinct recognition in our medical schools.

The writer was greatly impressed by this article, as he has had many evidences of its necessity. The two cases reported in the following article emphasise this, because each case depended for its diagnosis upon the accuracy of the skiagraphist, and on account of inefficiency the patients were allowed to suffer for longer or shorter periods the extreme pain of renal colic.

A remarkable circumstance about these two cases is that the first case, that of Mr. B., was skiagraphed by means of the plant that afterwards accompanied

the First Expeditionary Forces to the Front, and this plant was probably used in one of the examinations of the second case, Private S.

The writer strenuously opposed the sending of so inadequate a plant, and demonstrated to the heads of the A.A.M.C. the necessity of having the latest up-to-date apparatus ; but though they recognised the wisdom of the contention they considered the necessary expenditure prohibitive, and over-ruled the objections which had been demonstrated. (*Vide* article "X Rays in War," ARCHIVES OF ROENTGEN RAY, Nov. 1914.)

It is not considered professionally proper in an article of this description to discuss the work of fellow-practitioners, but unless some properly constituted authority steps in and insists on the just recognition of Electro-therapeutics and Diagnostics in our medical school work, the future of Radiography will continue to be anomalous, and any medical man who possesses a plant, however trumpery, has the right to call himself an "X Ray Specialist," and thus bring so important a branch of our profession into disrepute. Radiography and Electrotherapeutics generally, are firmly established as part of our surgical and medical armamentaria, and it is imperative that our universities and medical schools should give them that recognition which they deserve, and without which they will continue to be the happy hunting ground of mere dabblers.

RENAL CALCULI IN RUDIMENTARY KIDNEY.

By FERGUSON LEMON, M.B., B.S., Melbourne.

A MOST unusual case of renal colic came to my notice some little time ago. Interesting from the fact that for twelve months the patient suffered recurrent attacks, each increasing in intensity and shortening in periodicity. Interesting also from the fact that for twelve months the case baffled accurate diagnosis even with the use of X rays. Most interesting of all from the fact that where proper X-ray technique was used a group of six renal calculi was found midway between the kidneys and the bladder. These on operation were found to be imbedded in a fibro-fleshy mass surrounding the ureter at the level of the crest of the ilium on the right side. Pathological examination of the stones would seem to prove that it was a non-functionating rudimentary kidney or a vestigium of the Wollfian duct that contained these stones.

The patient (Mr. B., æt. 30), a young athlete, was suddenly struck down on his wedding day by his first attack. Dr. A. (physician) was called in (March, 1914), and diagnosed it as lumbago. He treated the patient accordingly for a period extending over five months. At first the patient was able to attend to his business, but eventually the attacks became so frequent and so exhausting that he had to apply for sick leave, and has not been able to return to his work since.

As the patient was not making any improvement, his wife, who, previous to her marriage, was a sister in one of our large public hospitals, asked that a skiagram should be taken. In August the skiagram was taken by Dr. B. (skiagraphist), who gave a negative diagnosis.

On August 20th the patient was seen in consultation with Dr. C. (physician), who gave it as his opinion that the cause of the trouble was renal calculi, and advised exploratory operation, notwithstanding the evidence of the skiagram. This was not undertaken, but as an alternative tuberculin was administered.

On September 11th Mr. D. (surgeon) was called in, and suggested that the symptoms were those of renal calculi ; but on reference to Dr. B. (skiagraphist), who stated definitely that his results were negative, Mr. D. decided against operation.

The treatment given after this was hot air, massage, and aspirin, at times morphia, till on October 6th the patient saw Dr. E. (physician), who advised that another skiagram should be taken especially of the spine and right lumbar region, stating as his reason for so doing that while the symptoms were technically those of renal colic, the trouble might be early caries of the spine. Dr. B. (skiagraphist) took another skiagram and again gave a negative diagnosis (Fig. 1). Dr. E. suggested that a spinal belt be worn, but neither this nor any other treatment gave any relief, the patient continuing to have the attacks with equal severity and frequency.

On November 26th the patient left Dr. A. and called in Dr. F. (surgeon), who diagnosed the case as one of floating kidney, and advised fixation. He operated accordingly on November 29th. The patient made a very bad recovery, the attacks, in place of being intermittent, became persistent with severe exacerbations two or three times daily.

Dr. G. (surgeon) was then consulted, who diagnosed neurasthenia, administering aspirin and bromides in large doses, without any improvement.

After one exceptionally severe attack on December 17th, Dr. F. again operated over the seat of pain and severed the nerve ; but this did not give rise to any improvement, and from that time on he was practically confined to bed, as any attempt at movement gave rise to a severe attack.

On February 9th, 1915, friends advised the patient to see a clairvoyant ; as he was too ill to go himself, a flannel belt he was in the habit of wearing was sent. From this the lady diagnosed as follows :—" A mass of stones between the kidney and bladder, and both the bladder and appendix were inflamed." She advised certain treatment, which they carried out. The attacks became less frequent, and the patient was able to get up every day, and though suffering great pain he did not have another severe attack until April 24th.

On Saturday, April 24th, the writer was called by a brother of the patient to see if anything could be done to relieve his pain. The patient was lying face downwards on a couch, he was pale and perspiring, his teeth solidly

clenched on a corner of the pillow, his right hand pressed into the right lumbar region, and his eyes shot with the agony of pain. A true, typical case of renal colic. A sixth-grain injection of morphia was ordered to be given every two hours until relief was obtained.

After diagnosing the case as one of renal calculi, and upon enquiring into the history of the case, the wife of the patient gave the particulars already related, and showed the skiagrams taken by Dr. B. The plates, which were of a very poor order, showed on close inspection very little detail, but in the right lumbar region an indefinite mass could be seen, which, on getting well away from the plates against the skyline of shadowy clouds, showed discrete shadows in the mass. These were probably ureteral calculi, but on account of the general poorness of the plate it was impossible to come to a definite conclusion as to their identity.

The patient was advised to have another skiagram taken when he had sufficiently recovered from his attack, and subsequently on April 28th a thorough X-ray examination was made under difficulties, the patient shaking all the time as with an ague, neeessitating several plates being taken before one sufficiently definite could be produced. This plate (Fig. 2) showed a group of six distinct shadows in the right lumbar region close to the crest of the ilium.

The peculiar distribution of this group made it difficult to arrive at a decision as to what they actually consisted of. Although in the line of the ureter they were so widely placed that only one conclusion could be drawn—that is, the lowermost shadow had evidently blocked the ureter, causing the upper end of the ureter to become sacculated much in the same way as the pelvis of the kidney distends under the influence of a hydro-nephrosis ; however, whatever the condition was, it was one necessary for surgical interference, and Dr. Kilvington was called into the case. He was also puzzled as to the actual condition of affairs existing, but advised immediate operation to remove the foreign bodies.

On May 3rd Dr. Kilvington operated with the writer's assistance, Dr. Margaret McLorinan giving the anæsthetic. When the ureter was exposed a peculiar reddish fleshy fibrous mass was found surrounding the ureter about the level of the pelvic brim, and in this mass was imbedded five peculiarly shaped calculi ; the sixth was not found in the mass, but Dr. Kilvington, on searching down along the track of the ureter came on it enclosed in a fleshy fibrous mass. These were all external to the ureter, and for fear an obstruction might be in the ureter itself, this was opened by a longitudinal incision, and a flexible probe passed down into the bladder and up into the kidney without giving any evidence of a stone. Evidence was discovered of concretions in the appendix, but owing to the possibility of soiling the peritoneum, Dr. Kilvington elected to leave the appendix alone for the present, and stitched up the wound, leaving a rubber and gauze drain. Except for a slight secondary hæmorrhage on the first night, the wound healed rapidly and well, and for about two weeks the patient had no

recurrence of pain. On walking about before leaving the hospital he again suffered from an acute attack of pain, and continued to suffer occasional attacks till June 13th, when he had a very serious attack requiring the administration of morphia.

A further X-ray examination was made on June 22nd to see if by any chance any calculi had been left behind, but everything was apparently normal except the appendix, which showed evidences of thickening and concretions. Thinking this might be the cause of the attacks of pain still continuing, Dr. Kilvington again operated, when a long unhealthy appendix was removed, which was filled with a mass of concretions. The patient made a very satisfactory recovery, but as in the first instance a secondary hæmorrhage set in on the third day, but it did not delay the healing of the wound in any way.

Though decidedly better than he has been since his first attack, he still complains of pain in the same area of a more or less persistent nature, with occasional acute acerbations.

The nature of these stones was puzzling (Plate 3). They were not in the ureter, nor apparently had any connection with the kidney, and the question rose—were they a group of calcified glands? To assist at arriving at a definite conclusion, one of the stones was sent to Dr. Bull for analysis. He stated that they were composed of acid phosphate of calcium, and were undoubtedly of renal origin. This examination of Dr. Bull's pointed to the only conclusion possible—that a rudimentary kidney or vestigium of the Wollfian duct had functionated at some time and had found an outlet into the main ureter. This outlet had probably become blocked by the lowest calculus, and the rest of the vestigium continuing to secrete urinary products, but unable to get rid of the urine thus formed, allowed the watery part to be re-absorbed, leaving the solid insoluble matter to form these calculi. The peculiar shape, the intense hardness, and the fact that they contained only insoluble urinary products serves to fortify these conclusions. It is regretable that portions of the fleshy fibrous mass in which these stones were imbedded were not removed for microscopical examination, and it was only on discussing the source of these stones after the operation was completed, that this possibility was presented.

Apart altogether from the whys and wherefores of this condition, the patient was originally a perfectly healthy man, a strong athlete with no trace of neurosis or neurasthenia about him till his first attack on his wedding day, and since that time he has had the best attention from our leading physicians and surgeons, who unfortunately relied upon a skiagraphist for the confirmation of their opinion.

Report of Dr. Kilvington (Surgeon).

When I first saw the patient referred to in the above article, the history, together with the definite X-ray picture, pointed to a case of impacted

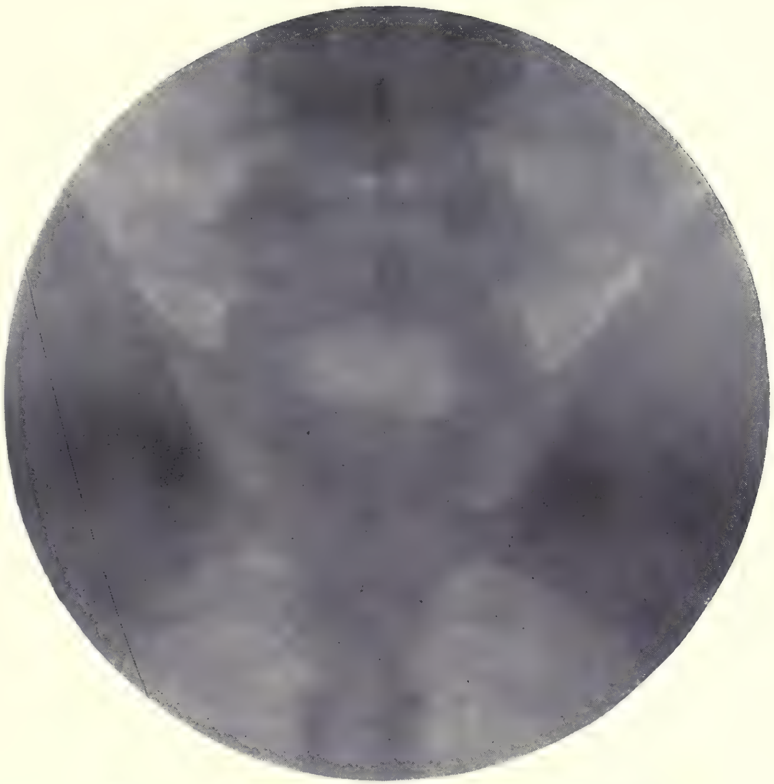

FIG. 1.—Skiagram taken by Dr. B., October 17th, 1914.

FIG. 2.—Skiagram taken by author, April 28th, 1915.

RENAL CALCULI.

PLATE 17.

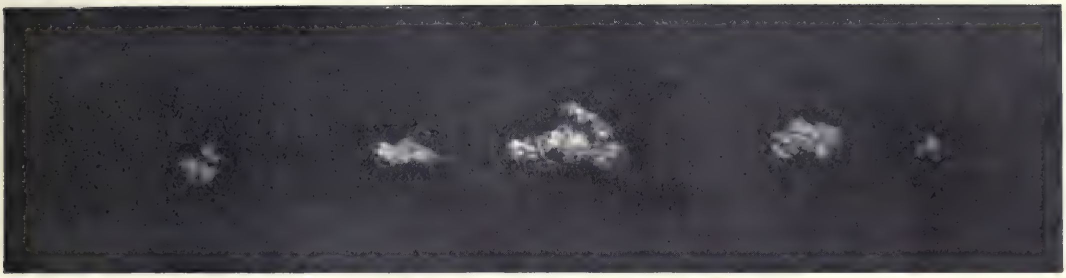

Fig. 3.—Calculi photographed to actual size.

Fig. 4.—Skiagram of Private S. taken by author, October 25th, 1915.

RENAL CALCULI.

Plate 18.

ureteral calculi. Even at this stage the position of some of the shadows was a little out of the ordinary course of the ureter.

At the time of the operation, which was performed by the usual incision inside the anterior superior iliac spine and, of course, extraperitoneally, the following facts were made clear :—

First :—The main ureter was undoubtedly quite clear of calculi as it was opened and a probe passed up to the kidney and down to the bladder.

Secondly :—The group of calculi lay in a line just external to the ureter imbedded in a curious fibro-fatty tissue, they were hard, grey-white in colour with jagged projections, and six of them (the number as shown by the X-ray plate) were removed.

Thirdly :—They were not present in a definite tube, but owing to the scarring round the nephropexy area it was impossible to follow anatomical structures upwards.

Fourthly :—A very thorough examination during the operation and during the subsequent appendectomy failed to reveal any other abnormalities, while the region of the vertebral column was specially attended to.

My own impression at the time of the operation was that these were calcified tubercular glands ; but Dr. Bull is certain from their composition that these concretions are renal in origin. The only possible explanations are that they lay in a second ureter of the right kidney which had been more or less obliterated by the presence of these concretions, or that they lay in the substance of a rudimentary and practically functionless kidney.

In this connection I think a cystoscopic examination of the bladder would be interesting, to discover if a second ureteral orifice is present on the right side.

At present the patient has still some pain, though not so severe, and of a slightly different nature from the original one. It is felt in the back in the right iliac region and over the outer side of the hip. Its character and distribution make me suspicious that the iliohypogastric nerve may have been implicated in the nephropexy operation previously referred to in the article

Report of Dr. Bull (Bacteriologist, Melbourne University).

I have made a microscopic and chemical examination of the calculus forwarded from your patient B., and find it to consist of acid-calcium phosphate, and would consider it of undoubted renal origin.

Second Report of Dr. Bull.

I have examined the second calculus forwarded from patient B. It appeared similar to the first specimen, of which the composition proved to be acid-calcium phosphate. The second specimen was a little larger than a pea, but was very irregular in shape, and presented a small, mulberry-like

excrescence at one part. The calculus was enveloped in a thin capsule of fibrous tissue which could be peeled with some difficulty from it. The substance was white, hard, and amorphous, and on section showed no evidence of central nucleus or of laminations.

The small mulberry-like portion consisted of several tiny rounded discrete particles of similar character and appearance, but distinct from the main mass of the calculus.

The appearances are more suggestive of calcification occurring in the site of old inflammatory processes than of ordinary calculus laid down in orderly laminated fashion around a central foreign nucleus. Probably the capsule present is due in part to condensation of surrounding tissues as the result of the calculus acting as a foreign body.

Two Renal Calculi in Left Kidney.

This case is not worthy of any special mention, being simply one of two well-defined calculi in the left kidney ; but the circumstances surrounding the diagnosis were so much on a par with the previous case that it deserves to be chronicled.

Private S., a returned soldier who was one of the original force that effected the memorable landing at Gallipoli, gives the following history of his case :—While in the trenches he was suddenly struck down with acute pain in the left side, and was afterwards surprised to find large quantities of blood in his urine. He reported himself to the Field Ambulance, they sent him on to Lemnos. There he was skiagraphed, and a negative decision was given. As the pain and bleeding had ceased he was, at his own request, allowed to return to the trenches.

While charging the Turkish trenches he was suddenly struck down by what he thought to be a bullet in the back. On this occasion he was so bad that he could only reach the dressing station with the help of a comrade. He was greatly surprised when the surgeons could find no trace of a bullet wound. Copious hæmaturia manifested itself, and he was sent direct to Alexandria, where he was again skiagraphed. Here, according to his own description, everything was done to ensure a successful diagnosis, and as he puts it, " Five sand-bags were loaded on my stomach to flatten me out," but again the diagnosis was negative.

Blood continued to appear in the water for some weeks after the original pain had ceased, but when he was quite well he wished to return again to the front. However, the surgeons in charge returned him to Melbourne as unfit for duty.

Here he entered the base hospital, and the surgeons there diagnosed renal calculi. He was sent by them to the skiagraphist for confirmation, but again after *three* separate examinations a negative diagnosis was given, and no operation was performed.

Confident that some trouble existed in the kidney, the soldier appealed to

the writer privately to have a skiagram taken. This was accordingly done, with the result that on taking the first plate (Fig. 4), two well-defined renal calculi showed in the left kidney. The surgeon in charge at the base hospital was privately notified of the existing condition, and the soldier was successfully operated upon.

NOTES ON THE RADIOGRAPHY OF THE GALL BLADDER.

By Neil Macleod, M.D. Edin., Radiologist, Shanghai General Hospital.

This my first essay in the publication of radiological matter should, I feel, be prefaced by an expression of my great indebtedness to Sir James Mackenzie Davidson, having had the good fortune to be one of his pupils in 1900 at Moorfields Hospital.

The radiographic examination of cases of suspected gall bladder disease furnishes a growing and encouraging percentage of success. As hitherto reported, the bulk of that success has been mainly where definitely margined shadows indicate biliary calculi.

These notes are concerned not with such cases, but with the more frequently occurring ones where shadows are not definitely margined, which nevertheless indicate not only calculi but other gall bladder abnormality, an interpretation tested by operation holding out a reasonable prospect of further increasing success percentage.

So far, only 29 cases have been examined by the writer of these notes between January, 1914, and May, 1916. The 17 cases referred to here are numbered to indicate the order in the series of 29. Some of these cases were also seen by me in the capacity of consultant, either before or after having been dealt with in their radiological aspect.

1st Case.—In January, 1914, I was asked for the first time to examine for biliary calculi, suspected to be present in a young man of 124 lbs., failed to find evidence of such, but reported irregularity of shadowing in the gall bladder region.

Any practical knowledge I then had of the radiographic appearance of the region consisted only of what every radiographer has who examines the right kidney under compression, the central ray passing perpendicularly to a plate behind the subject lying on the back.

Disappointment was mitigated in this case by no stones being felt in the gall bladder by the surgeon, Dr. J. W. Jackson, of Shanghai, who, having had the appendix also under suspicion, proceeded to deal with and removed it, after clearing away adhesions which he reported also involved the gall bladder.

Aware that gall bladder disturbance arises from adhesions, I regarded the shadow irregularity at the time merely as a coincidence. On looking over the negatives recently, in the light of later cases, I have now to confess that most of the "irregularity" was caused by gas in the bowel, and also that I had entirely overlooked one which I would now regard as evidence of a distended gall bladder.

3rd Case.—On 6th July, 1914, Dr. Venable, of the American Presbyterian Mission Hospital at Kashing, wrote:—"I operated on our patient Saturday. I found just the condition you predicted—a contracted sacculated gall bladder about the size of my thumb, containing three

medium-sized gall stones and about a drachm of thickened bile. There were three more stones in the cystic duct. . . ."

The case, a Chinese lady, had been examined in the end of June, when the prediction had not been quite so definite as stated, but shadows were reported not definitely margined, and probably due to multiple gall stones.

4TH CASE.—A French priest, weighing 154 lbs., was examined 24th November, 1914, and declared to be a case of multiple gall stones. Dr. Billinghurst, Shanghai General Hospital, removed from the gall bladder 163 stones, varying in size from a barley grain to a medium-sized pea.

All of these stones were enclosed in a gauze bag, forming an elongated mass about the size of my thumb, and strapped in the right epigastrium region of my assistant in three different positions. Shadows were obtained on three plates, all different, and the stones not to be distinguished individually. Six of these stones were next enclosed in thin paper, forming a single layer, and strapped and radiographed similarly. They presented quite definite edged though very faint shadows, which could be counted.

Radiographed end and sideways, in direct contact with a plate, the bag gave the mottled shadows sometimes seen in negatives or prints of multiple stones in a gall bladder. Anyone who has not radiographed gall stones successfully I recommend to repeat the six gall stone experiment, placing them $1\frac{1}{2}$ inches to the right of the middle line and the same distance from the rib margin.

Three radiographs of this case were made, not one of which was like the other. This variability of the shadow in a series of consecutive negatives, if compression or the position of the patient had been altered when the plates were changed, points to their biliary origin and usually prevents stereographic projection.

5TH CASE.—A woman weighing 102 lbs. furnished, in January, 1915, one small oval shadow, at the lower edge of, but quite distinct from a much larger oval one, thought to be that of the gall bladder. Dr. Billinghurst removed an oval stone, about the size of an almond, from the cystic duct, where he said it had been probably acting like a ball valve. This stone cast a comparatively dense shadow.

6TH CASE.—Examined for biliary calculi, no evidence of them was found in a man weighing 160 lbs. I ventured the opinion that whilst some of his symptoms indicated digestive disturbance, others indicated serious cardiac mischief, of which the patient died two months later. On post mortem examination no stone was found in the bladder. On looking at the radiographs recently, there is, however, to be seen a previously overlooked shadow which might indicate a distended gall bladder.

7TH CASE.—A woman who was jaundiced and weighed 125 lbs. furnished a blurred shadow in the gall bladder region. Multiple stones were reported as probably present. Dr. E. Jackson operated, and removed several stones.

8TH CASE.—A woman of 127 lbs. furnished no irregularity in the lower liver region, but a marked projection of its dome was present. Some months later, in Germany, a liver abscess was evacuated.

11TH CASE.—This was regarded as probably one of multiple stones in a man who arranged but failed to return to be stereographed, left Shanghai, and has not been heard of since.

12TH CASE.—One which furnished a single shadow. Not operated on.

13TH CASE.—A man of 170 lbs., with a doubtful shadow, complicated by gas bowel shadows. Not operated on.

16TH CASE.—A woman of 105 lbs. in December, 1915, examined for calculi, had a shadow suggested to be that of a distended gall bladder, doubtful as to stones being present. Dr. E. Jackson removed an enlarged bladder containing no stones.

Though there could be little doubt that the larger of the two shadows in the 5th Case was cast by the gall bladder in a thin subject, it was not till this 16th Case, also a thin person, had to

be reported on, that the possibility presented itself of distinguishing a condition of the gall bladder apart from calculi.

17th Case.—A Greek lady of great girth, a visitor to Shanghai, furnished a shadow interpreted to be a gall bladder enlarged and probably containing stones. Not operated on.

24th Case.—A lady of 130 lbs. weight, and slightly jaundiced, had typical colic for years. A multiple stone shadow was reported. Dr. Billinghurst removed 43 calculi in January, 1916.

25th Case.—A lady of 165 lbs., of whom Dr. Charles K. Roys, of the Union Medical College, Tsinan, Shantung, wrote 31st January, 1916:—"I am sending you a patient, Nurse . . . ., who has been in China about one year. Two years ago she was operated on in America and her appendix removed, also various adhesions about the cæcum and the ascending colon were cut. She seems to have had a typical Jackson's veil over the cæcum. She went on without symptoms until about six months ago, when pain and tenderness appeared in the right iliac region, with constipation, irritability of the stomach, and occasional attacks of vomiting. We have just examined her under ether and find a distinct mass in the right iliac region, but we would like to know its relation to the cæcum and the lumen of the bowel.

"If you can find it convenient to take a plate, or a series of plates, after bismuth feeding. . . ."

A barium meal, and three days later, after purgation, an enema was given. On screen examination the ascending and the first part of the tranverse colon could not be separated from each other by palpation, standing or lying, but there was no undue detention of the meal in that region.

From the time of the pain, commencing always in the right epigastrium and spreading upwards towards the right shoulder, occasionally downwards and "around"—a possible origin was suggested in the gall bladder. The patient then disclosed that the several medical men who had had her under observation, including Dr. Roys, had suspected the gall bladder. This led me to radiograph that region, after clearing away the barium and gas which had been plentiful at the hepatic flexure in three radiographs. Two gall bladder negatives were taken two days apart, with an attempt in between to get rid of gas. A distended gall bladder was reported to Dr. Roys, but on account of gas complicating the lower part of the shadow no declaration could be made as to stones. In this connection it has to be noted that I had a negative in my possession where such gas, overlying the twelfth rib, allowed the rays to go through it so that it looked as if that part of the rib had been punched out.

On 5th March Dr. Roys wrote:—"You will be glad to learn that Miss . . . ., whom you so kindly skiagraphed for us, has been operated on and is doing well. Acting upon your suggestion we made an incision over the region of the gall bladder, through the sheath of the right rectus, and found adhesions all over the fundus and lower surface of the organ, especially strong over the fundus.

"These were divided and the gall bladder very carefully palpated, including the ducts down to the duodenum, then the gall bladder was probed from the fundus, but no stones were found. The organ was much distended at the beginning of the operation, but after the removal of the adhesions it emptied itself almost at once, and a considerable amount of pure bile was vomited. So we concluded that the adhesions had produced a kink in the duct, and tried to prevent their recurrence by inversion and the rubbing on of sterile petrolatum. The adhesions in the right iliac fossa we explored, but did not disturb."

On 7th May Dr. Roys wrote:—"She is very much improved by her operation, and has no pain or other signs of returning adhesions. Her constipation also is much less."

26th Case.—A young Parsi lady, sent for right kidney examination, furnished on February 18th, 1916, a well marked oval shadow of what was thought to be a distended gall bladder, or a cyst of the kidney, the shadow of which it overlapped and projected from outwards.

From the description of the attacks of pain as to location, its time and extension, and the absence of subjective or objective urinary signs, I ventured to suggest the gall bladder as preferably the seat of disturbance, and arranged for a stereograph to be made eight days later,

when the abnormal shadow had disappeared completely, but in the same region a very definite small one was seen in both negatives and could be located as close to the surface, a curious location for a stone in the gall bladder.

Had the gall bladder emptied itself?

The problem furnished by this small shadow was solved the following day by a similar one appearing in the lower pole of a man's kidney, and also in a radiogram of the compression cushion itself, the section of which disclosed a valve rubber washer folded on itself!

This cushion had been radiographed a few days previously to study certain faint markings in its structure which had been projected through a thin kidney case. No ring shadow was then seen.

This case is now being watched.

27TH CASE.—A slightly jaundiced man of 130 lbs. was examined 1st March, 1916, when a shadow interpreted as due to multiple gall stones was reported. Examination and report were repeated six weeks later. Operation deferred.

ANALYSIS.

Of 29 cases examined, 17 were reported as presenting abnormal shadows; of these 17, 9 were operated on and the interpretation confirmed, the other 8 being without features regarded as justifying operation so far.

Of the 12 cases with negative reports, one early case proved to have no calculus on post mortem examination, and a gall bladder shadow was overlooked; one had an irregularity in the dome of the liver, probably due to a liver abscess evacuated later; at least three others had not gall bladder trouble.

In twelve of the 29 cases it was uncertain whether the symptoms were of gall bladder (including cystic and common duct) or of gastro-intestinal origin, none of them having typical biliary colic or jaundice. Nine of these twelve furnished no radiographic abnormality, three were regarded as having distended gall bladders, two of which were reported doubtful as to stones.

One of the 29 was sent for examination of the cæcal region, and was reported as having, in addition to adhesions there, gall bladder distension also, and this was confirmed by operation as to both points, there being also gall bladder adhesions.

Ten out of the 29 had typical biliary colic, and nine of these ten furnished positive radiographic results; of the nine, confirmation by operation was obtained in six, while three of the nine were not operated on; four of the ten cases had jaundice.

Reckoning only those cases in which the positive radiographic report was tested by operation, viz. nine, the percentage success of all cases examined is 31, calculi being present in six, giving 20 per cent., and three having distended gall bladders, or 10 per cent.

Since nine cases reported with positive results and operated on were *all* confirmed, of the eight cases similarly reported but not operated on the presumption is that some at least are probably correctly interpreted, in which case the percentage of success would be appreciably higher. Were three of the 29 cases excluded from the calculation as not having gall bladder trouble, the percentage success would be still higher.

Technique Employed.

Tubes.—The first 11 cases were examined with ordinary, the last 18 with Coolidge tubes.

Power was obtained from the public alternating current supply, a Siemens 4 K.W. transformer and high tension rectifier being used.

Spark Gap.—Point and flat disc—$3\frac{1}{2}$ inches in the 4th Case, 4 to $4\frac{1}{2}$ inches, according to the thickness of the subject, in the rest.

Milliampèrage.—With the ordinary tube 2 to 3, with the Coolidge tube 8 to 22.

Exposures.—Ten seconds to 2 minutes.

A.C. Distance from plate, $23\frac{1}{4}$ to 27 inches.

Position of Patient.—All on the back. Face down was also tried in two of the cases in which no positive results were obtained.

Central Ray directed always perpendicular to the plate, preferably through a point marked in the right epigastrium, $1\frac{1}{4}$ to $1\frac{1}{2}$ inches from the middle line, and the same distance from the rib margin.

Compression in every case with a rubber cushion, which inflated fully, measured 10 by $7\frac{1}{2}$ by 7 inches, the cushion contained in a double silk cover, securing always the same degree of inflation. Compression was applied perpendicular to the plate by an apparatus consisting of a vulcanite ring fastened to two uprights, passing through two guides like the moving part of the Albers Schoenberg compressor, but with the tube in its ordinary stand and tube holder not integral with the compression apparatus, made by a native smith at a cost of a fifth of the Albers Schoenberg apparatus, and admitting of an 8 by 10 single field or an $8\frac{1}{2}$ by $6\frac{1}{2}$ stereo one.

Caution.—In the gall bladder region all shadows, the margin of which is defined by bowel gas, must be regarded with great caution and rejected entirely if wholly so defined.

Until a shadow of the normal gall bladder has been obtained and a standard set up, the pronouncement that in a given case the bladder is enlarged should be made only when the enlargement is marked.

With the shadow of an organ, the long axis of which is more or less in the direction of the rays, variables in its production, such as obliquity of rays, respiratory mobility of the organ itself, possible alteration of its shape and position from compression, size dependent on distance of anticathode from plate—these variables have to be kept in mind during interpretation.

EDINBURGH WAR HOSPITAL, BANGOUR.

[Reprinted from *Edinburgh Medical Journal*, March, 1916.]

. . . .

"Yet when thy country's wrong to action moved,
You rose to save, and left that ease you loved;

. . . .

Hail, and farewell! may heaven defend thee safe,
And to thy natal shore and longing friends
Restore you, when thy destined toils are o'er."

(*Hamilton of Bangour's Poems*, 1748.)

There must be few institutions in the country which so admirably lend themselves to the purposes of a great war hospital as Bangour village, which in times of peace serves as the asylum for the rate-supported insane of the city of Edinburgh. Built in 1904 by the Edinburgh District Board of Lunacy—now the Edinburgh District Board of Control—it was formally opened in 1906 by the Right Honourable the Earl of Rosebery. It was constructed on the "village" system from plans by Hippolyte J. Blanc, R.S.A., with whom was associated as medical consultant the late Sir John Sibbald, Retired Commissioner of the General Board of Lunacy for Scotland, and it embodies all the most advanced views on the arrangement and construction of a modern asylum. "No boundary walls enclose any of the houses, nor are there any fenced areas . . . all roads and walks being open as in an ordinary village . . . and the appearance is that of an ordinary city suburb."

The hospital is situated in the county of Linlithgow, 14 miles from Edinburgh, 2 miles west of the village of Uphall, and 4 miles east of the town of Bathgate, on the estate of Bangour, 960 acres in extent, including about 200 acres of woodlands, and stands from 500 to 700 feet above sea-level on sloping ground with a southern exposure.

It is served by a private railway 2½ miles in length, a branch of the Edinburgh and Glasgow main line *via* Bathgate. The Bangour railway leaves the main line one mile west of Uphall station. It passes through the small hamlet of Dechmont, which, belonging almost wholly to the District Board of Control, is being laid out on the garden-city principle, and is inhabited by its employees. There is a station at Dechmont, and the line terminates at the station of Bangour, which is within the grounds of the hospital and close to the power-station and workshops.

For the purposes of a war hospital the station has proved of the greatest value. The hospital trains conveying the wounded are drawn up at the platform, and the station is so arranged that the ambulance cars can be run up alongside the train, entering at one end of the station and leaving at the opposite end, so that there is no cross traffic to delay the transfer of patients from the train to the wards. At the station the patients are easily sorted out by the medical officers into medical and surgical groups, and the staff of the Red Cross Society convey them direct to the wards in which they are to be

treated, in this way avoiding the unnecessary transferences which result from sorting out in the hospital. It has been found possible to evacuate a hospital train of 100 patients and to have them comfortably in bed within a space of forty-five minutes.

Accommodation.

The hospital provides accommodation for 1,350 patients, divided provisionally into 830 surgical and 520 medical beds, and these are situated in 14 separate buildings to be described later. By converting the day-rooms and dining-rooms of the asylum into wards, 400 beds have been provided beyond the number accommodated in the asylum.

X-Ray Department.

This department is under the charge of Mr. Thomas Rankine, who has not only provided the whole apparatus but has generously placed his services at the entire disposal of the staff.

Three rooms are allotted to the X-ray department : one large room where the photographs are taken, a smaller room with a large viewing desk and the necessary accommodation for preserving negatives and records, and a dark-room.

The large room, 30 feet long and 18 feet wide, accommodates the whole X-ray apparatus, which includes the radiographic machine, two full-length X-ray tables, tube stands, screening stand, the collection of X-ray tubes, the battery and rheostat for Coolidge tubes, and the usual minor equipment.

The radiographic machine, which is of American manufacture, comprises a 10 H.P. motor and dynamo capable of delivering 15 KVA energy at the tube, a closed core transformer with five steps of transformation from 25,000 to 100,000 volts, and a special arrangement for fluoroscopy, a trolley switchboard and an automatic time switch. This machine was selected after trial of seven other patterns, as the most powerful and efficient apparatus obtainable. It delivers with ease 100 to 150 milliampères at the tube, and enables exposures to be made in a fraction of a second if required. A portable X-ray apparatus is available for cases which require investigation, and which cannot be sent from the ward to the X-ray department.

The routine work is almost entirely performed with a milliampèrage of 50 to 100, which allows photographs of almost any part of the body to be obtained in one or two seconds, and almost entirely obviates the necessity for intensifying screens, with which, however, the hospital is adequately provided.

An automatic timing device of special design ensures exactness of exposures of all intervals between one-sixtieth second and ten seconds.

The screening stand is only employed in cardiac and intestinal cases, when it is desirable to observe movement. Radiography of the eye and orbit is performed by the Dixon localising apparatus, which is a complete unit for this special work.

Of the two large X-ray tables, one is fitted with an adjustable tube box beneath, and is arranged for screening over the table if required ; it is also

furnished with means for making rapid stereoscopic pictures with the patient above the lamp.

The work of this department is performed mainly with the lamp above the table—a tube-stand of heavy construction with removable compression diaphragms, and stereoscopic movements and verniers, in addition to all usual adjustments, is employed.

The X-ray tubes in use are almost all of American manufacture, and include Macalaster Wiggin, Bauer, and Coolidge tubes. These latter are sufficiently novel to merit some slight description.

The Coolidge tube marks the latest advance in tube design, and appears to overcome all the old difficulties of stability of tube and penetration. The degree of exhaustion of these tubes is so high that no discharge will pass through the tube even at 100,000 volts pressure, unless under certain conditions which are entirely within control. To render the tube conductive, it is necessary to make incandescent a small tungsten filament, which forms the cathode ; the electrons then thrown off from the incandescent filament form the vehicle which carries the high-tension current across the lamp.

The carrying capacity of the electron stream varies with the heat of the tungsten filament ; the heat of the filament is directly controlled by a battery, rheostat and ammeter in local circuit, hence it becomes possible to produce an electron stream or vehicle of any desired capacity for the passage of high-tension current.

It is obvious, as the output of the transformer and the carrying capacity of the vehicle are both within control, that any desired combination of penetration and quantity of X-ray to the full capacity of the generator can be employed at will. In this new tube, therefore, the penetration and quantity of X rays is definitely controlled along a wide scale of light variation, whereas the old type of tube has practically only one note. The tube has no secondary radiation from the glass, hence photographs with perfect definition to the edge of the plate are obtained without the use of a diaphragm with its attendant disadvantages. Milliampèrages of 100 to 150 have no bad effect upon the tube, the life of which, unlike the older forms of X-ray tube, appears to be indefinite.

The routine of the department is as follows :—Cards are supplied by the department and upon these the physician or surgeon fills in the name of patient, nature of wound, etc., and these cards are sent to the X-ray room. These case cards are then consecutively numbered, classified, and the most urgent cases dealt with first.

Each patient on entering the X-ray room is given a label bearing a number corresponding to that upon the case card, and this label is affixed to his bed on his return to the ward. The same number is photographed on the plate or plates of the subject. Dressings are if possible entirely removed.

In cases where no foreign body is thought to be present, antero-posterior, and, if possible, lateral photographs are taken. If the presence of a foreign

body is suspected, one A.P. exposure is made to ascertain the general condition and to find the foreign body.

These plates are then developed, the patient meanwhile remaining on the X-ray table ; while the development is in progress the same routine has been gone through with the next patient on the second table. The developed plates of the first case are then examined, and if they furnish all the possible information, the patient is then returned to his ward. If, however, foreign bodies appear upon the radiogram, it is necessary to take a stereoscopic pair of photographs to determine with accuracy their position and depth. For the exact determination of these, neither costly nor elaborate apparatus is required; a plate tunnel made of wood and just large enough to permit the easy insertion and withdrawal of a photographic plate of requisite size, and fitted with two lead or iron wires at right angles sunk into the under side of the roof of the tunnel is employed. This tunnel is placed under the patient in such a position that the point of intersection of the cross wires (which is indicated upon the upper surface of the tunnel) is approximately under the already ascertained place of the foreign body, and a mark is made upon the patient's skin to correspond to the intersection point of the lines in the tunnel. The centre of the lamp is now adjusted as nearly as possible centrally over the tunnel, and a stereoscopic pair of photographs are then made by moving the lamp 3 or 5 cms. on each side of its central position. The distance of the anticathode from the plate is noted—this distance may conveniently be 50, 60, or 70 cms. After development of the plates, the wires in the tunnel will have recorded themselves along with the foreign body upon the plates, and the shadows of the foreign body will be found at different distances from the line. This apparent displacement or parallax of shadows is measured by compass or scissor points, which are then applied to a chart of graphs, and the depth at which the foreign body lies in the tissue is instantly and accurately determined, either in relation to the skin or to any bony point which appears on the skiagram. With the mark upon the patient's skin as centre, a cross is drawn upon the patient's skin to correspond with the lines on the plate. From these lines the position of a foreign body is measured and marked upon the skin, and a note of its depth recorded upon the folder which will contain the negative when completed. This case is now finished, and by this time the first plate of the second patient is ready and the same process is repeated.

The accuracy of this method of localisation is infallible ; the cost of a set of tunnels for the three usual size of plates is the whole outlay, which need not be more than a few shillings. (The technique and chart of graphs may be obtained from the radiographic department of the hospital upon request.)

This method of localisation has the further advantage that all plates so taken may be viewed by means of the stereoscope, either by the Wheatstone apparatus or the simpler and equally effective Pirie stereoscope (the latter is in constant use in the X-ray department), and in fracture cases is specially useful for indicating the actual position of the fragments. Illumination of negatives for stereoscopic or other examination is provided by an electrically

illuminated viewing desk capable of showing twelve large negatives simultaneously. Apparatus is also available for reducing negatives to lantern slide size, and for producing the prints which are made of cases of more than usual interest.

To facilitate reference, all plates are stored in coloured folders and indexed on the coloured card-index system. To the group of wards under each surgeon a distinctive colour is assigned, and all cases from each group are stored in the folders and indexed on cards of the colour appropriate to the group. Folders of each colour are stored separately and consecutively, hence each surgeon's cases form a complete section. Plates required for the wards are asked for and identified by the number on the label hanging on each bed.

SOCIÉTÉ NATIONALE DE CHIRURGIE DE PARIS.

Fondée en 1843. Reconnue d'utilité publique en 1859.

A PRIZE OF 50,000 FRANCS FOR THE BEST MECHANICAL HAND-APPARATUS.

A GENEROUS donor who wishes to remain anonymous has offered to the Société Nationale de Chirurgie, a prize of 50,000 fr., to be handed over to "the maker of the mechanical apparatus supplying the place of the hand best. All competitors must belong to allied or neutral nations. They are to present to the Society mutilated men who have been using their apparatus for at least six months. The Société de Chirurgie will experiment each apparatus on mutilated men for the length of time it thinks fit. The apparatus rewarded is to remain the property of its inventor. The competition will be closed two years after the end of the war."

MM. FAURE, KIRMISSON, QUENU, RIEFFEL and ROCHARD, who make up the Committee elected by the Société de Chirurgie, inform the public of the condition of the competition as stated by the donor, and beg any person wishing to compete to send his memoir and apparatus to M. le SECRÉTAIRE GÉNÉRAL de la Société Nationale de Chirurgie, à Paris, 12, rue de Seine.

REPORTS OF SOCIETIES.

REPORT ON THE RADIUM TREATMENT AT THE ROYAL INFIRMARY, EDINBURGH, DURING THE YEAR 1915.

By DAWSON TURNER, M.D., F.R.C.P.

[Reprinted from *Edinburgh Medical Journal*, March, 1916.]

SIXTY-FOUR patients attended for radium treatment during the past year, whereas sixty-three attended during the previous year. Of these forty-two were in-patients and twenty-two were out-patients. The war seemed at first to have the effect of diminishing the number of patients desiring radium treatment, but afterwards the number increased. As compared with the year 1914, there is a rise in the number of in-patients and a diminution in the out-patients. Twenty-four of the patients suffered from inoperable malignant disease, nineteen from rodent ulcers, nine from exophthalmic goitre, and four from nævi. Of the malignant cases sixteen were carcinomas and eight were sarcomas. As is well known, more benefit

is to be expected from the use of radium in the latter class of cases than in the former. Myeloid sarcomas in particular yield very readily to radium, and when they are so situated as to be capable of being efficiently rayed the complete disappearance of the growth may be anticipated (*vide* Case VI). Of the carcinomas, those situated in the vagina or cervix appear to be vulnerable to radium, and if localised can in many cases be entirely removed. Unfortunately, recurrence after a variable interval is the rule. Life, however, is in the meantime prolonged; the patient may be greatly benefited by the relief of pain, the cessation of discharges, and by the gain of health, strength, and weight. Five such cases have been under treatment during the year 1915. A preliminary curetting is often of service; this acts by removing part of the growth and by permitting the radium salt to be applied more effectively to the root of the disease. The radium should not, according to the writer's experience, be screened in these cases except by such coverings as are necessary to preserve it from injury or to protect the sound tissues. Considerable doses of 3000 or more milligramme hours are required.

Detailed references to rodent ulcers are not now required, for the beneficial action of radium is generally acknowledged. If uncomplicated and situated on the skin they invariably do well and a cure can be expected. If they recur, which may be due to an insufficient primary treatment, they are easily removed by a second application. The cosmetic result leaves nothing to be desired, and there is scarcely any subsequent contraction of the skin—a point of importance in the region of the orbit. Nine cases of exophthalmic goitre received radium treatment; two of these were males. In accordance with the results obtained in previous years, and embodied in the annual reports of the radium treatment in the Royal Infirmary, such cases are benefited both in general health and in the special symptoms, even though there may be no actual reduction in the size of the affected gland. In one case (No. V.) the gland after radium treatment had extended laterally and the neck measurement had increased from 13¾ inches to 15¼, but the patient was stronger, better, less nervous, and the tachycardia had diminished. Colwell and Russ [1] state that Rave draws attention to the marked effects that X-ray exposures have upon the symptoms associated with pathological conditions of the thyroid, but that the effects upon the tissue of the organ itself are apparently of a very slight character. These experiments were performed upon cats and rabbits, and comparatively large doses were given. The writer is unacquainted with any similar experiments on animals with radium, but his clinical experience inclines him to agree with Rave's results — indisputable benefit is occasioned without any necessary obvious change in the organ, though it may become in the region of the exposure harder and denser. To avoid injury to the skin small doses should be given to different areas and the softer rays should be cut off, but where, as in hospital practice, time has to be economised, only very penetrating rays filtered through silver 1·4 mm. thick and with the radium salt maintained at a distance of 2 cms. from the skin should be used. Twenty milligrammes of pure radium bromide can under such conditions be applied for twelve hours without damaging the integument, and the patient can now be sent home for two to three months before making a fresh application, for the beneficial effect takes time before it is fully produced. Thus the treatment is short and simple, the dose can be accurately gauged, and the excitement to be avoided in such cases of having to face a working X-ray tube is obviated.

The further experience gained in the therapeutics of radium, while limiting its field of utility, has the more firmly established its value in certain well-defined directions.

The serious disease in which it is of most service is undoubtedly rodent ulcer, in which it may be almost said to act as a charm. It will cause with the least injury to the skin the disappearance of papillomas, nævi, and recent cheloids. In exophthalmic goitre it is of great service. It is of value in malignant disease, either as a prophylactic after operation, or as a substitute for operation in cases in which it is undesirable to operate for any reason, or in inoperable cases as a palliative.

To illustrate the effect of radium in rodent ulcer two photographs from a collection are appended. The one was taken before the application of radium, the other some months

afterwards. The following are brief notes of the more important cases treated, with the exception of rodent ulcers, which have been purposely excluded:—

1. *Exophthalmic goitre* in a woman of 31, recommended by Professor Gulland. Nervousness, weakness, tachycardia (150), perspiration, enlargement of thyroid. No exophthalmos. Neck 13¼ inches. This patient was given at different times during nine months a total dose, through silver 1·4 mm. thick, of 2,350 milligramme hours. The applications were distributed over the gland so as not to expose the same area of the skin twice. The radium was also maintained at a distance of 1½ cms. from the surface. This patient is very much better and has been able to return to work. Professor Gulland wrote in April last concerning her, "I saw the patient to-day and am really very pleased with her. She is steadily improving." The neck measures 12¾ inches, the gland is harder and denser. She feels strong instead of weak, she does not perspire, and the pulse is almost normal.

2. *Exophthalmic goitre* in a male, aged 33, recommended by Professor Gulland. Duration, four years. Weakness, sickness, exophthalmos, swelling of thyroid. Neck 16 inches. This patient resides 150 miles away; he comes every six or eight weeks for a night's treatment. He has had a total dose, administered as in the last case, of 2025 milligramme hours during the last year. He is greatly improved, has gained 9 lbs. in weight, has had no sickness since the radium treatment was begun. Exophthalmos diminished, strength increased. Pulse down to 105. Neck 15½ inches. Professor Gulland writes on 27th January, 1916: "I am very pleased indeed with this patient. Not only has his thyroid gone down but he looks very much better, and his heart is much more satisfactory. I don't see any reason now why he should not go back to his business as a draughtsman, at any rate for a short day."

3. *Exophthalmic goitre* in a female of 22, recommended by Dr. R. A. Fleming. Duration, five years. Diarrhœa, nervousness, palpitation (125), slight exophthalmos. Thyroid enlarged, neck measures 13 inches. She was given doses amounting to 1140 milligramme hours over the thyroid, and at her last visit a dose of 480 milligramme hours over the thymus. The neck measured 13 inches after ten months of treatment, but she is less nervous, and better and stronger in every way.

4. *Exophthalmic goitre* in a female of 26, recommended by Dr. R. A. Fleming. Duration, two years. Mr. Miles removed the right lobe of the thyroid six months before the radium treatment. Benefit resulted from the operation, but recently the left lobe began to enlarge and the symptoms to recur. Slight exophthalmos, marked palpitation, and nervousness. During six months she was given a total dose of 1540 milligramme hours over the left lobe. She is now stronger and better and able to do some house work. Neck 12¾ inches.

5. *Exophthalmic goitre* in a female of 38, recommended by Dr. R. A. Fleming. Duration, six months. Weakness, nervousness, excitability, some exophthalmos, swelling of thyroid. Neck 13¾ inches. During the last six months she received a total dose of 450 milligramme hours. General condition better, tachycardia less, but neck, owing to extension laterally of left lobe, measures 15¼ inches. This is an instance of a general improvement associated with a further enlargement of the thyroid.

The other cases of exophthalmic goitre have been treated too recently to allow of useful reference.

6. *Myeloma of the sternum* in a male, aged 32, recommended by Professor Gulland for radium treatment on 9th March, 1915. Duration, two years, following an attack of pleurisy. The growth had steadily increased in size, and now was of the size of a large cocoanut adherent to the sternum. An X-ray examination suggested involvement of the mediastinum. The symptoms were increasing weakness, constriction of the chest, and shortness of breath. A consultation was held with Mr. Miles, who considered the case inoperable. The radium treatment consisted in the introduction by Mr. Miles of four aluminium tubes containing 10 to 20 milligrammes each of pure radium bromide into the right hemisphere of the growth, while at the same time external applications through silver screens 0·5 mm. in thickness were made

Thus the right hemisphere of the growth was subjected to an energetic cross fire of rays. The plan of treatment was to transfer at the end of a few days the internal tubes to the left hemisphere, but owing to the rapid diminution in the size of the growth it was not found practicable to introduce more than two of the tubes. The total dose amounted to 13,200 milligramme hours. A month after the treatment the growth had entirely disappeared. Professor Gulland remarked, in regard to this case, "that he had watched the tumour growing during the past eighteen months, that it was of very large size—quite as big as two fists—that he had been rather a sceptic as regards the value of radium in malignant disease, but that he was now quite converted. The growth was a myeloid sarcoma." The patient has regained his health and strength and is back at his work. That was the patient's state six months ago. Since then a small recurrence, consisting of a flat elevation about the size of a half-crown piece, appeared over the sternum. This was given during a period of four months small doses, amounting in all to 250 milligramme hours. The recurrence disappeared, but was followed by an ulcer about an inch deep with cleanly cut edges and extending into the eroded sternum. No pain is associated with the ulcer, which is now filling up. The patient is taking iodide of potassium on Mr. Miles' advice. The recurrence and the ulcer have not prevented the patient from continuing with his usual work. Professor Gulland writes on 13th January, 1916: "This patient had a long course of inunction and of iodide of potassium before the radium treatment, but without the slightest effect. The ulcer has impressed me more as a continued destruction of the tumour, which must have started from the centre of the sternum."

7. *Myeloma* in a female of 23, recommended by Mr. Dowden. *History.*—A year ago (October, 1914) patient complained of a gumboil on the right side of the superior maxilla. A dentist removed some teeth and sent her to see Dr. Gibbs, who found a dentigerous cyst. From a microscopical examination of a scraping from this Dr. Gibbs recommended her to consult Mr. Dowden. The latter, through an opening in the hard palate, scraped out the cavity thoroughly. Pathologist reported the growth to be a myeloma. It lay posterior to the superior maxillary bone. Radium treatment was recommended as a prophylactic. A tube containing 10 milligrammes of pure radium bromide was attached to the end of a wire and passed up into the cavity, and a dose of 1920 milligramme hours administered. This was in October, 1915. At the end of November she returned to her duties, and in February, 1916, no trace of a recurrence could be found by Mr. Dowden, and the patient felt perfectly fit and well.

8. *Recurrent sarcoma* in a female of 49, recommended by Dr. Maclagan and admitted by Mr. Miles, 15th July, 1915. Duration of disease four years. Patient has had several operations for the removal of the growth, but it has always returned quickly and grown bigger. There was now a large nodular mass projecting in the suborbital region and adherent to the maxilla. Pathological report, sarcoma. As Mr. Miles considered the tumour inoperable, treatment with radium was decided upon. Two tubes containing radium were introduced into the growth and capsules containing radium were applied externally, the latter screened by 1·4 mm. of silver. A dose of 5880 milligramme hours was given and the patient sent home, being told to return at the end of August. She did not return until 17th November. Dr. Maclagan wrote in August to report marked improvement. On readmission in November there was a large ulcerating mass closing the left eye. Mr. Miles, however, thought that the swelling was less. The mass was now so friable that it was difficult to keep tubes of radium introduced. External treatment was vigorously pushed and a dose of 5180 milligramme hours administered. During these applications the growth diminished markedly. Patient sent home. 1st February, 1916, the tumour has much diminished in size, and to left of external canthus is freely movable; it was fixed before. She can now use the left eye quite normally, and she feels much better and stronger. The condition had so far improved that the whole of the fungating mass was excised, and a fresh course of radium treatment was given as a prophylactic against further recurrence.

9. *Epithelioma of the cervix* in a patient

aged 63, recommended by Dr. Brewis. Admitted 14th June, 1915. Has complained of irregular bleeding for five or six months, but not of pain.

Per Vaginam.—There is a hard mass in front of cervix on anterior vaginal wall. Cervix friable; bleeds on touching. A preliminary curetting was decided upon. This was carried out by Dr. Brewis on 15th June. A tube of radium shielded below by leadfoil was introduced into the raw cavity and a dose of 5040 milligramme hours administered. Pathological report after curetting—"squamous epithelioma." On 7th October the patient was examined by Dr. Brewis, who reported that there was nothing abnormal to be felt now and that the part looked quite healthy through a speculum.

10. *Epithelioma of the cervix* in a patient, aged 30, recommended by Dr. Brewis. Admitted 6th July, 1915. Patient has complained for the last four months of loss of health and strength and of a reddish brown discharge. *Per vaginam.*—Vaginal portion of cervix rough, eroded, friable, bleeds easily, offensive discharge. Cervix widely involved, uterus fixed. After curetting, a tube of radium was placed in the cavity and a dose of 3360 milligramme hours administered. As the lower area of the disease had not been closely treated the radium salt was now applied to it and a dose of 3360 milligramme hours given. Total dose, 6720 milligramme hours.

30th September.—Patient much better, looks and feels a different woman, is stronger and stouter. The pain had also been removed. *Per vaginam.*—Cavity much smaller, granulations more superficial; a scraping withdrawn was reported by the pathologist to show squamous epithelioma cells. Uterus was movable. In consequence of the pathological report another dose of radium was given, amounting to 1920 milligramme hours. 10th December, patient improved both locally and generally.

3rd February, 1916.—Patient is wonderfully improved and does not look like the same woman. *Per vaginam.*—Surface quite smooth, not friable, parts more mobile, no abnormal discharge. Per speculum, slight redness posteriorily, which is tender to the touch, but the tissue is in no wise breaking down. Patient sent home, but to report herself regularly in case of recurrence.

11. *Epithelioma of the cervix* in a patient of 55, recommended by Dr. Brewis. Admitted 15th July, 1915. Patient has complained for some time of loss of health and strength, accompanied by pain and reddish discharge. *Per vaginam.* Vaginal portion of cervix cannot be felt, but per speculum can be seen to be completely tunnelled out by the disease. Patient was curetted and the pathological report confirmed the diagnosis. A radium preparation was now introduced into the tunnel and a dose of 3360 milligramme hours given. To the inferior portion of the disease a dose of 960 milligramme hours was administered. Total dose, 4320 milligramme hours. 30th September, she looks and feels better. *Per vaginam.*—Walls of tunnel covered by friable material, granulations thin, scanty, of necrotic debris. Disease appears to be more superficial, but there is not so much improvement in this case as in the last—No. 10. The granulations are reported by the pathologist to be malignant. Patient has not returned since.

12. *Recurrent cervical cancer* in a patient of 50, recommended by Dr. Brewis. Admitted 30th September, 1915. The patient's uterus had been removed fifteen years before by Dr. Brewis by vaginal hysterectomy. Patient has been well since the operation until the last two months, when an offensive discharge began.

Per vaginam.—An ulcerating eroded mass was found; this was scraped and tubes of radium were introduced into the sloughing cavity. A dose of 5880 milligramme hours was given. Pathological report—squamous epithelioma. This patient has not reported herself since the treatment.

13. *Tumour of left shoulder* in a male of 63, recommended by Mr. Dowden. Admitted 18th September, 1915. The X rays show that the humerus has lost its lime salts. On palpation, find uniform thickening of head and upper part of shaft of humerus; pain on abduction, sudden pains at night. Duration, six months. Has had hæmaturia. Tips of fingers so swollen that he could not close his fist. On 11th September an incision was made through the deltoid into the tumour and

three tubes of radium were inserted. There was a good deal of bleeding. External applications of radium were also made. Total dose, 12650 milligramme hours. The tumour turned out to be a hyponephroma, but it was diminished in size by the radium treatment.

14. *Recurrent carcinoma of soft palate* in a male, aged 47, recommended by Mr. Dowden. Admitted 7th September, 1915. The patient was operated on by Mr. Dowden on 2nd June and on 15th June, when the glands were removed for a carcinoma involving the soft palate and the right side of the mouth. In September, 1915, the patient returned with a recurrence. There was an ulcer below the scar on the right side of the cavity of the mouth. As a palliative measure a tube of radium attached to a holder was given to the patient to hold in the ulcer during his waking hours. A dose of 870 milligramme hours was given. Local burning and irritation was set up but the ulcer was improved.

15. *Tumour of posterior aspect of right thigh* in a female, aged 65, recommended by Mr. Graham. Admitted 9th September, 1915. Duration, five years, but has been growing more rapidly during the last six months. Mr. Graham operated on 31st August, and removed the growth. As a prophylactic measure 20 milligrammes of radium were introduced through a glass tube into the wound on 9th September. A dose of 2400 milligramme hours was given. Pathologist reported it was a fibroma.

16. *Recurrent scirrhus* in a female, aged 50, recommended by Mr. R. C. Alexander. Admitted 18th February, 1915. The right breast was removed three years ago for a scirrhous tumour by Dr. Henderson of Galashiels. Now in the region of the scar there is a lump 1½ inches long, firmly fixed down, and with an ulcer ¾ inch broad upon it. When recommended to me for radium treatment I suggested that the growth should first be removed by a surgical operation and that radium should then be applied to the wound as a prophylactic. As the patient refused all operative treatment she was given external applications of radium, shielded by 1·4 mm. of silver and with the radium salts maintained at a constant distance of 2 cms. from the surface. The position of the salts was also continually changed. A dose of 4400 milligramme hours was administered. On 13th April she returned. The lump and the hardness had disappeared, but the ulcer was still present and of the same size. Gave a dose of 960 milligramme hours to the ulcer. On 31st January, 1916, Dr. Henderson wrote to say that the patient was worse, that the part treated by radium had extended, and that a large fungating mass had appeared in the right axilla.

17. *Recurrent epithelioma of temple* in a female, aged 56, recommended by Mr. Jardine. She has been twice operated on by Mr. Jardine—on 14th April, 1915, and on 26th May, 1915—when a wide excision of the growth situated over the temple on the right side was made. On admission on 10th June there was a flat lump of hard consistence (above the scar) 1 inch long and raised above the surface. A dose of 330 milligramme hours of radium was given. On 20th July the part treated was better, but a new lump had appeared above the ear. To give her a stronger dose Mr. Jardine admitted her as an in-patient. A dose of 3630 milligramme hours was administered. On 9th September all signs of the growth had disappeared, but some facial paresis on the right side was present. Patient was dressed for about fourteen days after the radium treatment. The wound partially healed and the paresis diminished. She then left off attending, and has not returned since.

18. *Recurrent vulvar carcinoma* in a patient of 62, recommended by Dr. W. Fordyce. Duration, more than three years. First operation on 31st October, 1914, second operation in January, 1915, after which X rays were used, nine exposures, ¼ pastille at each, screen 1 mm. of aluminium. These had no observable beneficial effect, as the growth continued to increase. Another operation was performed. Radium treatment as a palliative was suggested on 17th November. The patient at this time suffered from great pain and could not sleep without opiates. Disease very extensive, involving the vulva and vagina. An attempt was made to apply radium to the ulcerated surfaces at the entrance of the vagina, but the tubes were only with difficulty maintained in that position, being constantly

pushed out. The thighs were protected by leadfoil. A dose of 2400 milligramme hours was given. Ten days after the exposure the patient's pain was relieved.

19. *Carcinoma of the cervix* in a patient of 37, recommended by Dr. Barbour. Duration, one year; pain on both sides and in back. Dr. Barbour made an exploratory incision on 9th July, 1915. Uterus enlarged, cervix rough and irregular and friable. Curetted. Pathological report, basal-celled carcinoma. Case inoperable. As a palliative radium was tried on 2nd September. An aluminium tube containing 20 milligrammes of radium bromide was introduced into the cervix and a dose of 2880 milligramme hours administered. A short time after the treatment the patient stated that the radium treatment had relieved her pain. No improvement otherwise was noticeable. Dr. James Harvey has written on 4th February, 1916, to say that the patient died in January, 1916, after suffering considerable pain, hæmorrhage, and discomfort from the involvement of the bladder and rectum.

20. *Sarcoma of left nasal cavity* in a patient of 74, recommended by Dr. Farquharson. Admitted 9th November, 1915. Duration, more than three months. Commenced by feeling of a choked nose, external swelling, etc. Pain at the back of the head. Dr. Farquharson operated on 18th October and removed the growth. Radium was suggested as a prophylactic. A radium preparation was attached to the end of a twisted wire and given to the patient to hold in the cavity, and a total dose of 200 milligramme hours was administered. Dr. Farquharson wrote on 3rd February, 1916, to say that as the attacks of hæmorrhage increased he advised the patient, on account of her great weakness and age, to give up further treatment.

REFERENCE.—[1] Colwell and Russ, *Radium, X Rays and the Living Cell*, p. 212.

RONTGEN SOCIETY

At the meeting of the Röntgen Society, on May 2nd, Mr. H. E. Donnithorne read a paper describing the various methods adopted, and in some cases discarded, for measuring X rays. Of all the methods, he said, the ionization method was the one which appeared to be most promising, and had been adopted in all research work. Mr. Donnithorne described a modification of the ionization method he had himself devised. In the course of discussion Mr. Schall defended the milliampèremeter, which, although it did not measure the total value of the current passing through the tube, did measure the mean value of the impulses. He thought that the milliampèremeter could certainly be relied on for ordinary radiography, provided account was taken of the penetrating power of the tube, the distance between tube and plate, and so forth. It was for treatment, and particularly for deep therapy, that an instrument was required, and here he had had great hopes of ionization methods. But he had now become a little doubtful, because it seemed as though the ionization instrument suffered from the same defects as every other method hitherto. They did not know what proportion of the X rays was being absorbed by the instrument.

Major Wilson, of the Canadian Medical Service, showed his new tungsten arc lamp for ultra-violet treatment, explaining that one of the electrodes was of pure tungsten, and the other was of carbon cored with tungsten, the tungsten powder being made into a paste and forced into the ordinary carbon, forming the filling of the central cavity. Various other arrangements were tried, but nothing was found quite so good as the carbon cored with tungsten. A mirror was used having a curvature such as to give a very slightly divergent beam. The President suggested the use of uranium in place of tungsten, the uranium giving a spectrum with even greater masses of fine lines than the tungsten, approximating to a continuous spectrum.

REVIEW.

Interstate Medical Journal, Vol. XXIII., No. 1, Saint Louis, Mo., U.S.

Quarterly Review on Roentgenology. — January, 1916.

This number contains an interesting review on the status of Roentgenology in the United States for the year 1915, by the Departmental Editor, Dr. E. H. Skinner, of Kansas City. The two outstanding features are:—(1) the general acceptance of the Coolidge tube, and (2) the increased confidence placed by the surgeon on the X-ray findings in gastro-intestinal cases. Attention is drawn to its greater adaptability for therapeutic use than in radiography where sharp detail is required, as in bone diagnosis, owing to the difficulty of getting a sharp focus spot on the target with this type of tube. A warning is given of the greater need of protection with this powerful apparatus.

The increased dependence of the surgeon on the roentgenologist in gastro-intestinal cases is ascribed to:—(1) the large increase in the number of installations; (2) better technique, in which the serial radiograph plays so important a part. A very large increase in the literature of this class of cases is noted, and that many articles are taking the X-ray findings as a matter of course.

In X-ray therapeutics there is a trend to taking a definite stand on the question of Malignancy. "Before long, the question will be not, 'Shall we operate, or not?' but rather, 'Is this a case for the surgeon or roentgenologist?'" At the present this seems premature, as American radiologists are not as familiar with intensive deep radiotherapy as they are on the Continent. The fact that surgery has been able to do nothing for late malignancy should not discourage the X-radiologist; it is possible that the judgment of eminent X-ray experts could help the surgeons who are "furnishing the medical brains for cancer education."

A marked increase in dental radiography is noted, giving rise to a lively discussion of the *rôle* played by defective and infected teeth in certain diseases—especially rheumatism and certain neuralgias—and which is still much to the fore.

Much new apparatus has been devised and found ready acceptance, and many new X-ray societies have been founded and conferences held, all tending to educate their members, and "spread the gospel of efficient Roentgenology." R. W.

NOTES AND ABSTRACTS.

RADIOGRAPHY.

The Roentgen Examination of the Appendix. — By Maximillan John Hubeny, M.D., Chicago.—(*Interstate Medical Journal*, January, 1916.) The object of the paper is to place confirmatory data in the hands of the surgeon, which, with other clinical findings, will warrant a diagnosis of chronic appendicitis. The early work of Holzknecht, Beclerc, Jordan, Groedel and others, in Europe, and Cole, Quimby, Imboden, George and Case, in America, is quoted. Of the two methods of visualizing the appendix, injecting an opaque enema, and ingesting an opaque meal, the latter is preferred. Fluoroscopy is preferable to plates, though the latter method should be used as showing details the eye cannot catch, especially the stereoscopic method for demonstrating retro-cæcal appendices or an appendix close to the cæcum or ileum, which might otherwise be overlooked. The one condition essential is that the lumen should be patent. The best time to look is six hours after a bismuth meal. [A shorter time after barium sulphate.—Ed.] The filled appendix may remain visible for days—Pirie reports a case persisting 43 days—but usually

empties with the cæcum. Exception is taken to Groedel's dictum that "every appendix which permits the entrance of an opaque meal is pathological," Moro having demonstrated cinematographically peristalsis in a dog's appendix. Failure to enter the lumen may be due to (1) acute inflammation, (2) enterolith, (3) adhesions or kinks. The information obtained by fluoroscopy and manipulation tells (1) the size, length, and calibre, (2) position and direction, (3) drainage, (4) mobility, (5) kinks, (6) location of applied pressure to visceral topography. This latter being important in view of the frequent association of pain on pressure over the appendix shadow, especially in abnormally placed appendices, where position of pressure - pain may mislead. Among the remote or reflex effects of a chronically diseased appendix are : — (1) Hypertonicity of the stomach with rapid emptying: more frequently a spasm in the stomach, the most common cause after gastric ulcer, of spasmodic hour-glass constriction. Barclay's statement is quoted that appendicitis causes an ileopyloric reflex, producing "appendix" dyspepsia, (2) stasis of cæcum (3) of ascending colon, (4) dyschezia from appendix, or cæcum, or both, lying on the brim of pelvis or below the brim. R. W.

RADIOTHERAPY.

Lung Suppuration after Tonsillectomy.—W. H. H. Wessler, *Associate Roentgenologist, Mt. Sinai Hospital, New York.—(Interstate Medical Journal*, January, 1916.) The term "lung suppuration" is used to designate infection of the lung due to aspiration after tonsillectomy. The term "lung abscess" being apt to convey the impression of a cavity filled with pus, an impression only partly true, not based on true conception of the pathological process and not in conformity with the Roentgen image. The clinical history suggests, and examination of portions excised at operation proves an inflammatory process, an aspiration infection with inflammatory processes in various stages of organisation and resolution, whose extent is usually out of all proportion to the small irregular areas of suppuration or bronchiectasis which may be at the centre of it.

Eight cases subsequent to tonsillectomy are reported, out of twenty-eight cases of pulmonary suppuration examined—28 per cent. A general anæsthetic was administered in all the cases. The symptomatology is remarkably uniform and sets in suddenly, the primary process being an aspirative broncho-pneumonia, the evidence of suppuration developing later—in from eight to fourteen days. In practically all cases the sputum is foul smelling, but the gangrenous process is secondary and represents a subordinate lesion. One case quoted noticed a gangrenous odour in her breath eight days before expectoration. Hæmoptysis is common and varies in extent, and may be frequently repeated. Pain is often present due to concomitant pleurisy. A predilection for the right lung is notable, six affecting the right and two the left. Physical signs are not distinctive and not reliable. Patients are not as a rule acutely ill. There are chill and fever with remissions, the temperature rarely exceeding 100°—102° F., with some cough and expectoration. The leucocyte count is moderately elevated, with polynuclear increase.

The Roentgen diagnosis is (apart from bronchoscopy) the most valuable for exact location and extent, the plate disclosing an infiltration of varying extent. A cavity may or may not show, depending on the density of the infiltration in which it is located, and on its size. In the series quoted cavities were noted in five of the eight cases with occasionally fluid contents—they are usually small. In two cases multiple, and in two situated at the hilus. Definite cure can be followed by the X-ray. Symptomatic cure may be associated with persistence of the infiltration. A persistent low grade inflammation is always a condition favourable to recrudescence.

R. W.

"X-ray Anaphylaxis." — A note by J. Bergonié, presented to the Académie des Sciences (*Comptes rendus*, April 10th, 1916), suggests that ordinary protective measures against X rays may be quite illusory in the case of those X-ray workers who have previously suffered from an X-ray burn. The author states that in a previous paper describing the pathogenic action of physical agents,

written in 1912, he had put forward the theory that a tissue once injured by X rays might remain for a long time, perhaps always, peculiarly sensitive to X-ray action. Recently he has had occasion to observe some facts which confirm these views, and dispel all doubts as to the matter.

A medical man, consequent upon a severe radiodermatitis, ceased all X-ray work, and avoided every contact with X rays, but recently by force of circumstances he was freshly exposed, and this is what Bergonié has observed :

On the normal skin the dose necessary for X rays to produce a definite reaction corresponds thereabouts to an irradiation of 15 minutes' duration, at 20cm. from the anticathode of a Chabaud-Villard tube emitting rays No. 6 Benoist, and excited by a current of $\frac{1}{2}$ma. But the dose necessary to provoke a similar reaction on the skin of the hands of this sensitive subject was very much smaller, being measurable in seconds instead of minutes, and in metres distance instead of centimetres. Bergonié calculates, taking every factor into consideration, that the dose provoking the reaction in the hypersensitive subject was to the normal dose as 1 is to about 1,600. This calculation was made on the formula $Q = \frac{I\,t}{d^2}$, in which Q represents the total amount of rays received per unit of surface, I the intensity of the current alimenting the tube under the same voltage, t the duration of the irradiation, and d the distance of the anticathode from the surface irradiated.

The reaction following this infinitesimal dose is not to be attributed to suggestion, for its features were objective enough. The tissues were tumefied, the fingers taking a "pudding" appearance, the folds of the skin became less numerous and deeper, epithelial tumours swollen and proliferating strewed the hands, and a very painful sensation of heat persisted at the skin; the nerve tracts also were painful, and the awkwardness of the hands was such as to make it impossible to write freely. The whole condition disappeared at the end of a few days in the absence of any fresh exposure. A special sensibility was to be noted in those parts of the skin which had previously been attacked by radiodermatitis.

From these observations and others which have occurred among radiologists, the author concludes that there exists a special sensibility of the tissues following a severe X-ray injury, and that this is no other than the phenomenon of anaphylaxis, which is thus shown to embrace the pathogenic action of X rays, and may probably be extended to include all physical agents.

INSTRUMENTAL.

Steel Instruments having Electrical Resistivity.—QUENU (*Bull. et mém. Soc. de Chirurgie*, May 9th, 1916,) has brought forward, in the name of Professor Bergonié, some surgical instruments, similar in appearance to those daily in use, but having the quality of not vibrating when in the presence of the electromagnet. This property permits them to be used in the extraction of projectiles with the Bergonié electro-vibrator. Hitherto it has been an inconvenience with the Bergonié method that while examining with the magnet during intervals of the operation, all the instruments have to be removed, even bodies such as copper and silver vibrating and causing errors. Bergonié has had recourse to a new metal, insensible alike to the attraction and to the vibrations provoked by the electro-vibrator. This metal is one of those derivatives of steel which are due to the researches of M. Guillaume. In this family of new metals one has been found which satisfies all the indispensable mechanical conditions of a surgical instrument, and possesses also an electrical resistivity, rendering all vibration of it impossible. The author has himself extracted four pieces of shell by this means. Neither the retractors nor the hæmostatic forceps have vibrated, and in view of their passivity the search for the projectiles has been greatly facilitated.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

LOCALIZATION OF BULLETS AND SHRAPNEL BALLS BY ONE RADIOGRAPH ON ONE PLATE.

By A. Howard Pirie, Captain C.A.M.C., France.

Many bullets and shrapnel balls are found quite undeformed in the wounded, and it is then possible to make a rapid localization of them from a single radiograph on a single plate. It is assumed that such bullets and shrapnel balls are of constant shape and size. This we assume from practical experience during the last 14 months. To carry out the method it is necessary to have a key radiograph (Fig. 1). This was made by making radiographs of a bullet and shrapnel ball at the following distances from the plate, 0, $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, and 6 inches. As Fig. 1 is reproduced natural size, it will act as a key radiograph to those who wish to use the method.

Bullets.—The diameter of a bullet casts a shadow which is proportional to its distance from the plate, no matter at what angle the bullet is lying. The length of the bullet is no guide as to its depth, but under all circumstances its

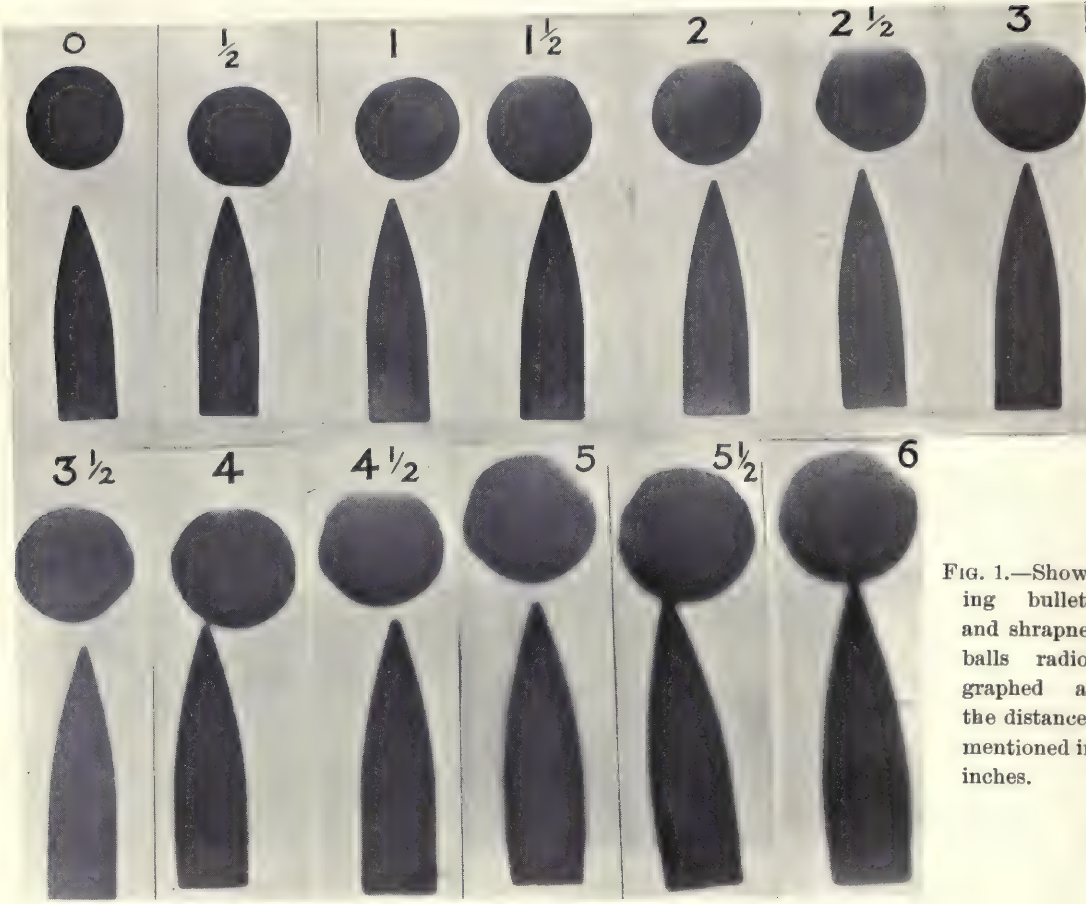


Fig. 1.—Showing bullets and shrapnel balls radiographed at the distances mentioned in inches.

breadth can be relied on. Consider first a bullet which lies parallel to the plate. It has a uniformly cylindrical part, which at one end tapers to a point and at the other end is blunt and indented. It is the uniformly cylindrical part which acts as our guide, and, by measuring its greatest diameter, then comparing this measurement with the corresponding key figure, we get the distance from the plate of that part of the bullet measured. The bullet should theoretically be in the perpendicular ray, but for practical purposes, if it is within six inches the error is small and may be neglected. With a fine pair of dividers the greatest diameter of the shadow is measured and the dividers then transferred to the key plate and there placed on the bullet shadow which they fit exactly. The distance of the bullet under consideration from the plate is then the same as the known distance of the bullet in the key plate. To find the other two dimensions in space the radiograph must be made with cross wires and the perpendicular ray falling on the cross. Join by a line the centre of the bullet to the crossing of the cross wires and calculate as follows :—

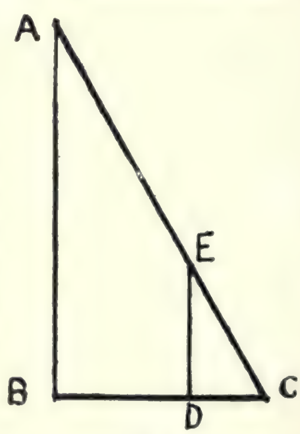


Fig. 2.

AB is the perpendicular ray.
B is the intersection of the cross wires.
E is the centre of the bullet.
C is its shadow.
DE is the depth as found above.

$$BD = \frac{BC\ (AB—ED)}{AB}$$

The point D can now be marked on the radiograph along the line joining the centre of the bullet to the crossing of the cross wires. By measuring the distance of D from the cross wires the two other dimensions in space are obtained.

As an example, take a plate showing the cross wires and bullet, as in Fig. 3.

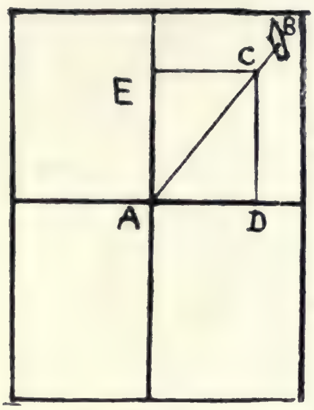


Fig. 3.

Join AB and measure it, say = 5 in.

Suppose the depth has been found from the key plate equal to 5 in., and that the perpendicular ray was 20 in., then the actual position of the bullet from the above formula $= \frac{5\ (20—5)}{20} = 3\frac{3}{4}$ in.

Measure from A $3\frac{3}{4}$ in. to the point C. Draw CE and C D perpendicular to the cross wires. E C and C D are the other two dimensions required and can be measured with a foot rule.

Shrapnel Balls.—The same method can be used for shrapnel balls provided that they are not deformed. Experience has proved that when they are slightly deformed a practical result is obtainable. If one wished to be theoretically correct as to the depth of the shrapnel ball one would have to use a formula which is much too long for every day use. It is as follows :—In Fig. 4 the cross wires and the oval shadow of the round ball are shown. Join A to the long diameter of the ellipse.

Let r = radius of shrapnel ball (a known quantity).
x = distance of centre of ball from plate.
Call distance AC = *a*.
Call length of perpendicular ray used = C.
Call distance AB = d.

$$\text{Then } x = C — \frac{C \times R}{a—d}\left(\frac{\sqrt{C^2+d^2}}{C} + \frac{\sqrt{C^2+a^2}}{C}\right)$$

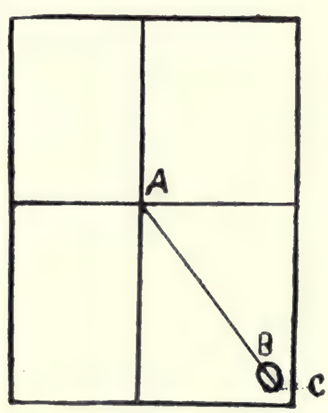


Fig. 4.

The Degree of Blurring of the Shadow.—On many occasions during a rush time, when we have made as many as 89 radiographs in a day, when only one radiograph had been made of a patient, we have been able to form an estimate of the depth of a piece of shrapnel or bomb by considering the degree of blurring of its shadow.

Fig. 1 shows how the degree of blurring increases as the bullet is placed farther from the plate. At the same time one can estimate how still the patient has kept by the blurring or sharpness of one of his bones near the shrapnel. When the FB is in the chest or abdomen no reliance can be placed on the degree of blurring. One would not advocate serious localization by such a method, but during rush times it has proved of practical value.

An electro-magnet installed in the operating room, supplied by 30 amps., 110 V. A.C., has saved the necessity of many localizations by X rays. The tremor of a bullet 2-3 inches below the surface can be felt, so that no X-ray localization is required. By means of a modified Hughes balance I have also been able to locate a bullet two inches from the surface, and even recognize a mass of metal at five inches. The Hughes balance responds to lead and brass when they are superficial, but beyond one inch I have not found it of practical value for these metals.

Conclusion :—

(1) Bullets and shrapnel balls of the present war can be localized by a single radiograph.

(2) The degree of blurring of the image is useful for estimating the depth of a foreign body.

(3) The electro-vibrator of Bergonié (electro-magnet) saves many localizations by X rays.

(4) The Hughes balance in a modified form is useful for locating foreign bodies.

RADIOGRAPHY IN GUNSHOT WOUNDS OF THE THIGH.

By Geo. Vilvandré, Capt. R.A.M.C.
Radiologist, No. 16 General Hospital, B.E.F.

I have in what follows attempted to put down some brief notes on a subject, the sadness of which strikes every surgeon, viz., "Gunshot Injuries of the Thigh," no one better realising that many men are better qualified to speak on the subject from the purely surgical point of view, but I was loth to keep unrecorded such good material as passed through my hands during over twenty months.

Among the many femurs radiographed the following examples have been picked out because of their interest in divers ways.

Looking back on these cases one comes to the conclusion that the prognosis of life or death, the loss or conservation of the limb do not so much depend upon the actual fracture or comminution of the bone as upon the degree of infection and virulence of the organisms present.

The gunshot injuries of the thigh range over such a scale, as is seen in Fig. 1, for instance, where a shrapnel bullet, localized by Barclay's method, has lodged in the muscles, to such utter destruction of the bone and soft

tissues as seen in Fig. 2 ; at first sight the two do not bear comparison, but tragedy may also follow in the wake of the inexperienced operating surgeon in such a simple case as No. 1, when the removal of the missile is not done

Fig. 1.

Fig. 2.

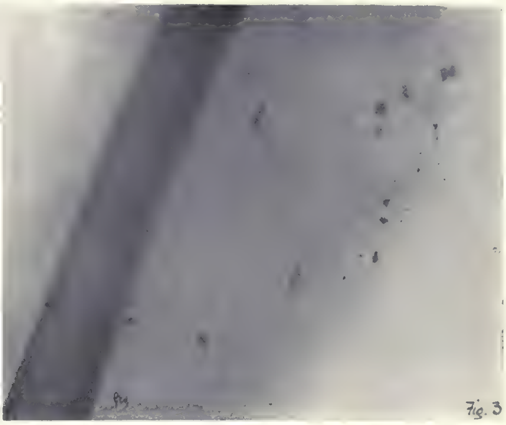


Fig. 3.

under strict aseptic and antiseptic routine, and the tragedy ends then *viâ* secondary hæmorrhage. The presence of pus to some men seems to be a

Fig. 5.

Fig. 6.

signal to neglect further aseptic precautions, as if secondary and mixed infection were a matter of small moment.

Better far to leave the foreign body untouched than risk the introduction of further sepsis, especially when that missile lies in close neighbourhood of the femoral vessels or larger branches.

Fig. 3 shows a thigh riddled with some eighty pieces of metal, practically each piece meaning an abscess. The systemic condition of the patient can be easily guessed at, but he ultimately did well, thanks to good treatment.

It is in such cases that Bergonié's Electro-Vibreur shows its great helpfulness as a localizing device, but in my opinion at least one X-ray plate should be taken to ascertain the condition of the bone and the multitude of pieces.

Through a great thickness of muscle vibration of the foreign body is not detected, but if the finger be placed more deeply in the tissues vibration will then be felt when the magnet is brought near. A sterile towel or bag should be attached to it to obviate contamination.

Greater damage to the bones seems to occur, in the cases I have seen, when the cancellous parts are struck, be it the upper or lower end. My series, I think, bear out this fact, and not only is the greatest trauma done there, but the risk and spread of infection are also greatest in those places.

Fig. 4 shows well the cancellous tissue and also the lines of force, and one at once realises what a splendid culture medium such honeycombed tissue offers to the invading bacteria, a sponge work of soft vascular warm tissue, a true paradise for germs and collections of pus, and though of course the key-note of surgical treatment in these cases is drainage, one realises the difficulty of it, and it is worth considering further, for the shaft of the bone must not be looked upon as a tube, but a multitude of tubings, many of which will escape drainage. Therefore, such as Fig. 5 and Fig. 6 will probably drain better and do better than Fig. 7. Such actually occurred, the lower end of the femur in the last was only just fractured at one point on the superior—anterior—surface, and the metal fragments penetrated the bone, causing infection.

The radiogram shows the hole of entry, subsequently enlarged with the spoon.

A cavity is seen, a cavity without drainage, a death trap from which infection spreads, from which arises an acute osteo-myelitis. Such contamination of the condyles of the bone will ultimately cause involvement of the knee joint, with all its sequelæ of septic absorption and joint disorganisation, and most usual ending, death, if amputation, in the hope of saving the leg, be postponed too long.

Methinks it would have been better for the owner of Fig. 7 if a complete fracture had taken place, for both the upper and lower fragments would have drained better, and, though wisdom after the event is an easy virtue, one questions whether surgical fracture as a means of treatment, or boring right through the bone to allow drainage, had not been a wiser procedure. The same specimen shows a linear fracture of some size, and here comes a point of importance. Such a crack in simple fracture of the femur would probably

Fig. 4.

Fig. 7.

not matter much, the patient, as is seen in some cases of cracked tibiæ, might have gone about his duties little the worse, but the importance of a fissure in war surgery, where almost everything seems to be infected, is not to be lightly passed. It often means the entry of infection in the cancellous part of the bone and the possibility of its spreading—therefore a cracked bone in a compound fracture should be set at rest and receive careful watching.

While X rays will indicate the relative positions of fragments, especially if two views be taken at right angles, while the presence of metal and cracks will be shown, the pathological changes in the bone infected by organisms and in parts necrosed, will appear only in a good radiogram, and they will appear with a great deal less intensity than is really the case. The image shown is

Fig. 7a.

less than the actual facts. Soft tissues, especially in the thigh, where the muscles are thick, absorb many of the medium rays just necessary to penetrate the bone, while the remaining rays of greater penetration help to cause loss of that contrast upon which accurate diagnosis of the true condition depends.

Fig. 8, though showing to some extent rarefaction in the condyles, did not give the true picture one saw later on laying the bone open.

Let us realise the limitations of the rays, we shall then better appreciate

their value, and better apply their yet tremendous possibilities. In such a case careful technique will help to localise the level of necrosis in the bone.

Even at the risk of overstepping my province a word or two must be written on loose fragments. Some surgeons advocate their being left *in situ* on the plea that these fragments act as bridges in the future formation of callus, but while one recognises the truth of the statement in the case of simple comminuted fracture, or even in those compound ones where infection is of low virulence, in the greater majority of cases loose fragments become islands of infected necrosed bone where the periosteum has died early for want of blood supply, and those fragments certainly do not tend to hasten repair nor the diminution of infection, they must follow the way of all necrosis, exit from the midst of life. Of this I am firmly convinced in gunshot wounds of the arms. Loose septic fragments tend to hinder drainage, blocking the broken ends of the bone and the drain channel through the tissues, helping

FIG. 8.

FIG. 8A.

to cause retention of septic material in a limb where the great size of the bone and the large surface of flesh mean so much absorption, both through the medullary cavity and by lymphatic channels. But the position of fragments from the main part of the bone is not usually as distant as may appear on the radiogram, and it is as well to bear this in mind, for strands of periosteum and blood vessels may still unite them to the shaft and influence their future behaviour. See Fig. 8a.

Distortion is one of the drawbacks of shadow pictures at short range, and that will be more or less felt according to the position of the tube in relation to the median vertical axis of the bone and the size of the diaphragm used—a size necessarily large when it is attempted to radiograph the greatest possible length of the femur.

That repair is possible in spite of long sepsis is shown by Fig. 9, where a large amount of callus is visible. The patient had been attended by several surgeons for the best part of a year, and at the time the radiogram was taken

was still discharging pus, but he was more than holding his own. So much depends upon the patient manufacturing his own resisting agents to microbic invasion.

It is easy to criticise, but X rays have the tactless power of revealing mistakes and errors in treatment.

Fig. 10 is an example. Excellent callus formation and strong union had taken place, but much shortening remained, as can be easily seen from the radio. The bone was set again and the result was good. The two cases are worth comparing, in one a localised strong callus, the ideal mend but for position, and the other a large mass, a waste of material, a continuous attempt at repair, an obvious sign of lack of immobilization—always difficult to apply in the upper part of the femur—and though things might have been far worse at best a failure at complete union.

As little movement as possible should of course be given to fractured thighs, and it has been our usual practice to take radiograms of these cases in the wards. The trouble to the X-ray operator is not inconsiderable, and the results one can get with a portable apparatus I think not so good as with that pertaining to a higher voltage, but after all the pain of moving is great, and no trouble can be too burdensome to spare these men a little suffering.

The last case is of double interest, first as a gunshot wound of the thigh, but more because of the presence of gas in the soft tissues.

After a successful application of the rays in the investigation of this dreaded complication of wounds in many of the extremities, one was glad to record the diagnosis of the condition in this case as pertaining entirely to the rays.

The diagnosis was made in the X-ray room, and the first sign of the trouble was the negative shadow above the patella.

A second plate showed the upper limit of the gas, *upon the knowledge of which level and depth depends the prognosis and further treatment.*

The wound was at the patella, just a fleshy wound and fairly clean. Having made the radiodiagnosis of gas, the clinical one could be made only some 6 in. higher by digital pressure, and might easily be passed unsuspected in the first rush.

In wounds of limbs sent to be X-rayed the technique necessary for the investigation of gas may well be applied systematically ; not only the structure of bones and foreign bodies should be shown, but an endeavour be made to radiograph the soft tissues as a routine. In this way the surgeon radiographer will be able to point to his operating colleague the presence or absence of gas in the tissues in all cases submitted, whether gangrene be suspected or not.

I had thought of the possibility of diagnosing gas gangrene chemically, the presence of the gas lending itself—to my mind—to the use of a small metallic pipette along which the gas, being under pressure since it is able to separate muscle fasciculi, would travel and cause a chemical reaction with some reagent.

I had thought that possibly we could use a hypodermic syringe, filled to some extent with the reagent, just as we needle for pus.

Major McKidd, C.A.M.C., at my request was good enough to do so. An all-glass sterile syringe filled with the acid was employed, and the bubbles of gas came readily without admixture with blood—in a pure state—although no reaction took place with the reagent employed the simple technique followed was so satisfactory that it gives the means of further investigation.

I understand that the composition of the gas is known *in vitro*, but a simple reaction may thus be found which may not be of purely academic value but of practical use. From the results of amputation and incision one is led to

Fig. 9.

Fig. 10.

believe that the presence of gas in the tissues is not always due to the same organisms, as is of course known bacteriologically, but the growth of the organisms seem to present difficulty and take time. A fatal end comes to some cases, whilst in others, where the tissues are equally penetrated with gas, recovery takes place through multiple incisions. One wishes to know whether the gas is or not in all cases of similar composition, and if not there may be found a different reaction in either. A reaction which will be quickly performed, and by any surgeon, and upon which a differential diagnosis may be made.

Finally, the next radiogram (Fig. 12) shows the same case as Fig. 11, but 36 hours afterwards. The superficial line of gas has been opened and dis-

appeared, but infection in the deeper tissues is still going on and has increased concurrently with a rise of temperature.

Looking at such a case and its radiogram, the thought readily comes to one's mind of the forcing in of oxygen into the spaces thus shown or the injection of hydrogen peroxide or any chemicals liberating free oxygen.

The third radio (Fig. 13) of the series shows the same case two days after the last. Position is not a small point to neglect in the radiography of such a subject, the thickness of the bone easily obscuring the negative shadow of the gas bubbles. Thus, we do see the value of X-ray diagnosis in gas. The progress of the infection we can watch and accordingly set our course of treatment.

I have met few cases of gunshot fractures through the neck and head of the bone. Possibly the patients never reach the base, but I have in mind the

Fig. 11.

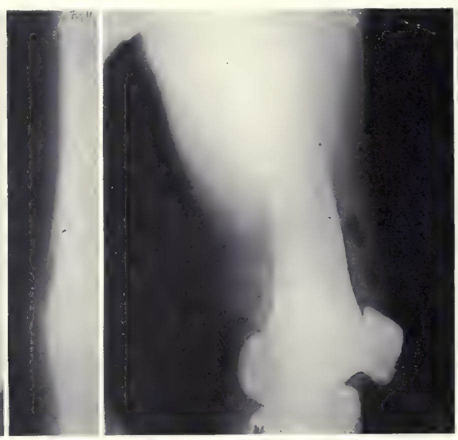


Fig. 12.
36 hours after Fig. 11.

Fig. 13.
48 hours after Fig. 12.

case of a German wounded in England, in whom the bullet struck the cancellous part of the great trochanter and drove in through the acetabulum a fragment of the head of the femur well into the pelvis and the bowel. A fœcal fistula followed, and later death. It is well to radiograph a fair part of the surrounding pelvis when dealing with a damaged hip.

The shadow of a hæmatoma will show on the plate if of fair size. I had one such case of the thigh lately, where the diagnosis was made from the radiogram after the patient had walked in the X-ray room.

Treatment was at once altered, the possibility of recrudescence of the bleeding and further complications being thus avoided.

My debt for these cases is owed to many officers with whom I have been associated, both in England and France, chiefly among whom my friend, T. Twistington Higgins. My thanks to them and to Colonel Thurston for permission to publish some of the material of two hospitals he has commanded.

INVERSE CURRENT.

By A. C. Gunstone.

With the recent increase in the size and output of the induction coil and mercury interrupter, the radiographer has met with increasing difficulty in preventing the "Inverse Current" from passing through his tubes, resulting in blurred photographs, and undue wear and tear of the tubes.

This difficulty became very serious, and appeared to absolutely defeat any hopes of further increase in the output of the induction coil type of apparatus, and seemed to indicate the high tension transformer and rectifier as the only solution for heavy currents.

There are mechanical devices for the suppression of the "Inverse Current," such as the Morton rectifier and mica disc valve, which are quite successful for medium intensities, but do not answer successfully for the heaviest output. In order that rectifiers of this type should operate successfully, it is obvious that we must separate the "Direct" and the "Inverse" impulses by a definite and comparatively long duration of time, in order that the rotating parts can move sufficiently far in order to open the secondary circuit, and thereby prevent the passage of the inverse current.

In order to operate a large coil at its very maximum efficiency, this interval of time must be made less, hence the difficulty in cutting out the "Inverse" by rectifiers of this type.

It is the object of this article to describe how the "Inverse Current" can not only be prevented from passing through the tube in the wrong direction, but can be sent through the tube in the right direction, and thereby help instead of hinder the production of the X rays.

Figure 1 shows the arrangement of the primary connections, from which it is noted that a double wound primary is employed, and a two-jet mercury interrupter so arranged that the magnetisation of the iron is not only made and broken, but is made, broken, and made again, but with the polarity this time reversed.

We will now follow the current when the jet is in the position shown on the diagram. The current enters "B" and passes to the left, and leaves the primary by the terminal "A" across the jets and back to the mains from the terminal "D." The core of the induction coil is magnetised by this current, and when the jet leaves contacts C 4 and C 2 the current in that section of the primary is broken, and an impulse in the secondary results, as in the ordinary manner.

The jets will now immediately afterwards connect contacts C 1 and C 3, with the result that the main current now enters the terminal "B" and goes to the right instead of the left, and leaves the terminal "C," so that the magnetisation of the iron is now reversed. An impulse in the secondary will result from this "make," but it will not oppose that due to the previous "break," as it is the "Inverse Current" due to a *reversed* primary impulse.

The direction of the secondary impulse due to the setting up of a magnetic field in one direction must obviously be the same as that due to the destruction of a magnetic field in the opposite direction.

The result then of the jets leaving the position shown on diagram, and connecting contacts C 1 and C 3, is to send two impulses through the tube,

FIG. 1.

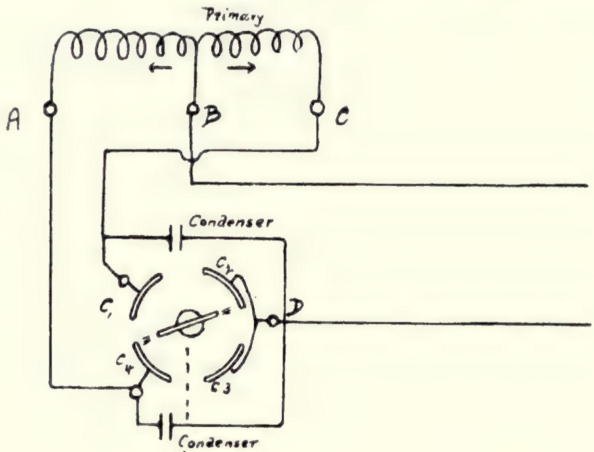
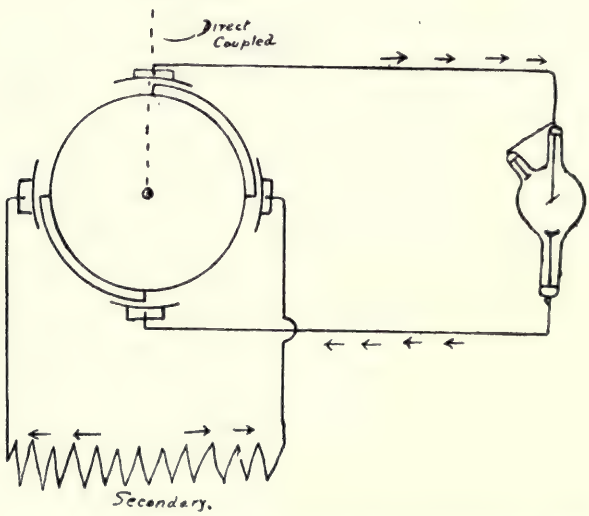


FIG. 2.



both in the same direction, the second impulse being due to the "make" or which usually appears as "Inverse."

When the jets leave this second position and resume the position shown on diagram No. 1, we shall have a repetition of these secondary impulses, but they will be in the opposite direction to the previous pair, as we are now dealing with a magnetic field of opposite sign.

A commutating disc as used on the high tension transformers is therefore used, and directly coupled to the mercury interrupter, by which means every second pair of impulses is turned round, so that for every revolution of the interrupter we obtain four pairs of impulses, every one of which is in the same direction.

It will be noted that this system of rectification does not demand that the

"Direct" and "Inverse" secondary impulses be separated by a definite time, on the contrary they can with advantage be made to follow each other so quickly as to merge into one flash. There is therefore no *time* wasted, for any given exposure time the maximum output of the coil can be obtained.

In comparing a large coil run on the lines above described with the high tension transformers, the value of the milliammeter reading and the heating of the tubes naturally becomes of interest.

As far as the absence of inverse current is concerned, the two are absolutely identical.

For the absolute limit of output the transformer is probably better, but for the heating of the tube the coil operated on these lines is undoubtedly superior.

In connection with this comparison I made some "falling plate" photographs of the oscilloscope tube connected in series with the X-ray tube. By this means the duration of the impulses and the extent to which the "Inverse Current" was used under varying degrees of "hardness" of the tube was fairly accurately indicated.

The photographs showed that for medium current intensities, say ten milliampères and a fairly hard tube, the "Inverse Current" was not sufficient to pass through the tube at all. The duration of the "break" impulse is unaltered. Therefore, for these intensities the new system is identical with the ordinary method of working.

The well known and much favoured "peaky" curve of the induction coil is retained, and the value of the milliammeter reading unaltered.

On softening the tube and increasing the output of coil, the photographs clearly showed the "make" impulse following after the "break," with a consequent increase in the time of duration of the secondary effect. However, under these conditions, with the milliammeter reading forty milliampères, the heating of the tube must be considerably less than would be the case with a transformer giving the same current, because the secondary effect is made up of two flashes, one of the "peaky" class, and the other of the lower voltage wave class, whereas the transformer would give two halves of one impulse, each of the same wave formation as the last named.

Further, the transformer gives this type of output for all intensities, and is therefore less suitable for screen work and deep seated therapy.

For these branches of the radiographer's work the system described with intensities up to ten milliampères is identical to the ordinary coil, which is universally accepted as being far superior to the transformer.

I therefore hope that this method of working will enable the induction coil to compare still more favourably with the transformer. There is now plenty of scope for the development of the coil and increase of its output, as we are not limited, as previously, by the question of the "Inverse Current." If the latter increases with the "Direct Current," so much the better. It will all help in the production of the X rays.

A CASE OF DIFFUSE FIBROMYOMA OF THE ŒSOPHAGUS, CAUSING DYSPHAGIA AND DEATH.

By Arthur J. Hall, M.D., Cantab., F.R.C.P. Lond.

Reprinted by permission from *Quarterly Journal of Medicine*, Vol. 9, No. 36, July, 1916. With Plates 24-32.

It has been somewhat the custom in former times to dismiss all growths of the œsophagus (with the exception of carcinoma) as mere pathological curiosities, having little or no clinical importance. The routine use of X rays in the diagnosis of diseases of the chest and alimentary canal must make us alter our point of view in this, as in many other respects. Any pathological condition in the thorax capable of causing a shadow on the screen cannot be left out of consideration in reading the radiogram. As will be seen from what follows, the absence of any previous record of such a condition as was found in this case confused the diagnosis throughout. Probably a more accurate diagnosis could have been arrived at had fuller and more varied investigation been permitted. It is only fair to those who from time to time were in attendance upon the patient, to point out that the lack of such fuller investigation or of any serious attempts at relief must be entirely and solely attributed to circumstances over which they had no control and for which they were not responsible.

History of Case.

Miss X., aged 17 years.

Personal history. An only child, always delicate, had suffered from bronchitis and asthma; she also had some slight spinal curvature. Always constipated; menses not begun.

Family history. Her mother died of carcinoma mammæ during the patient's illness: she was a highly neurotic woman.

Present illness. The first onset of symptoms connected with the œsophagus occurred in January, 1913, while she was living in Ireland. She was attended by Dr. Wright, of Dalkey, co. Dublin, who describes her symptoms as follows:

"For nearly a month, whenever she attempted to swallow she partly coughed up and partly retched up about half a pint of very frothy mucus, but the small amount of food she took never returned."

Dr. Wright was unable at that time to find any physical signs of organic disease anywhere. As the dysphagic symptoms persisted he advised them to consult Sir Robert Woods, of Dublin, who made an exhaustive examination of the throat and larynx, but could not find anything abnormal there. At his suggestion an X-ray photograph (Plate 26) was taken in March, 1913, by Dr. Edward Watson, of Dublin. He reported the presence of a shadow suggesting an intrathoracic growth in the posterior mediastinum, possibly due to enlarged bronchial glands.

On the strength of this report a provisional diagnosis was made of "enlarged bronchial glands, probably tubercular." The sputum was repeatedly examined for tubercle bacilli, but none were found.

The symptoms gradually disappeared, or, at least, improved so much that she did not require further medical advice for nearly sixteen months.

The difficulty of swallowing returned about June, 1914, whilst she was in Sheffield, and her medical man, Dr. Mylan, was called in. At that time she was complaining of dysphagia, cough, and vomiting, frequently bringing up a pinkish mucus.

Nothing definite was made out by physical examination, except that at one time the urine had a specific gravity of 1·032 and showed a trace of sugar, which disappeared entirely soon afterwards.

She lost weight rapidly, and during the next three months became gradually worse.

In August, 1914, she was screened after a bismuth meal by Dr. Rupert Hallam, of Sheffield, and he reported that there appeared to be a very narrow stricture in the upper œsophagus and another at the cardia; above which latter all the meal appeared to be collected.

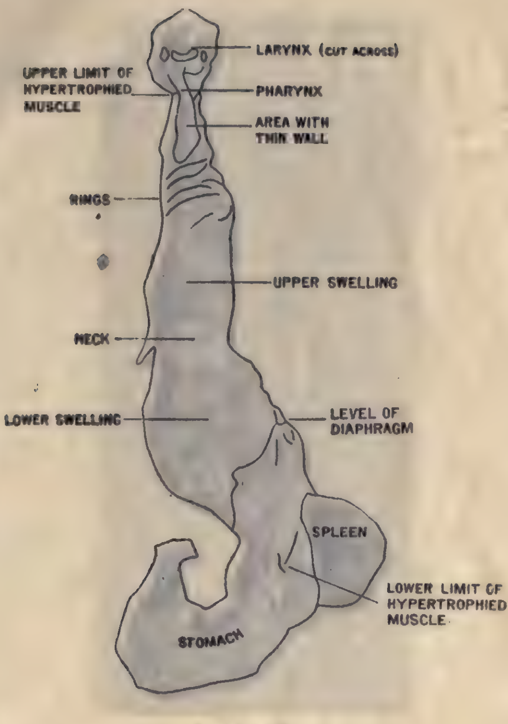
The presence of this lower shadow supposed to be due to the bismuth meal will be referred to later. Unfortunately no photograph was taken of the chest at that time.

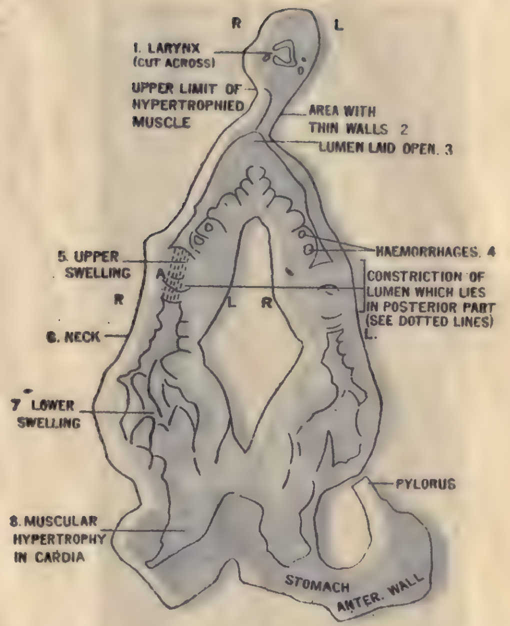
On September 15, 1914, I was asked to see her in consultation with my surgical colleague, Mr. Graham Simpson, and her medical attendant, Dr. Mylan.

The consultation took place under somewhat unusual conditions. The patient's mother lay dying of cancer upstairs, and they were anxious that she should know nothing of her daughter's illness, or of the consultation. It was therefore held late in the evening; we approached and left the house on tiptoe, and conversation took place in whispers only. It savoured more of a conspiracy than a consultation.

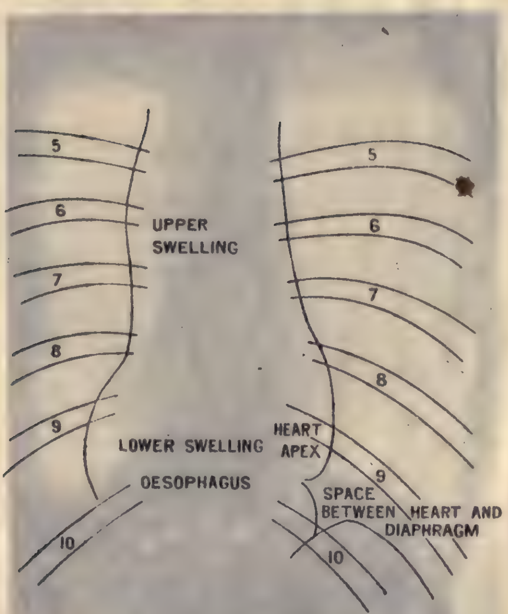
The history then given to us was as follows:

For the last few weeks she had been unable to swallow solids, and had had attacks of vomiting, which came on quite suddenly; these attacks

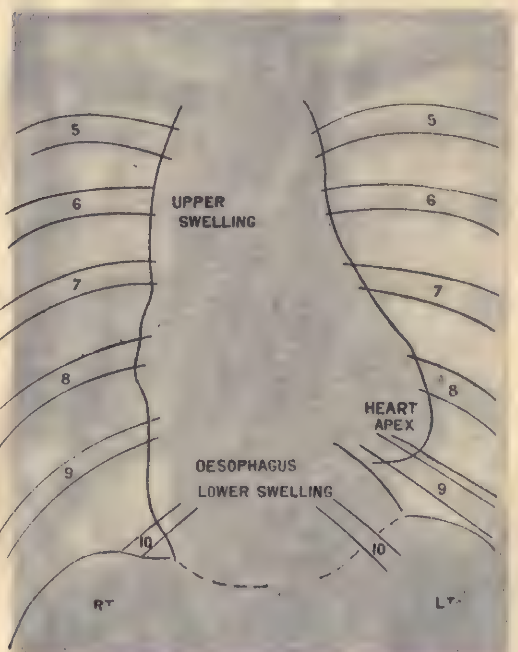




THE OESOPHAGUS HAS BEEN LAID OPEN BY A VERTICAL TRANSVERSE INCISION. AND THE ANTERIOR PORTION TURNED OVER TO THE RIGHT. THE INCISION STOPS AT THE UPPER PART OF THE TUBE.



RADIOGRAM TAKEN MARCH 1913
BY DR. E. WATSON. DUBLIN.



RADIOGRAM TAKEN DECEMBER 1914 BY
DR KNOX. LONDON. PREVIOUS TO BISMUTH MEAL.

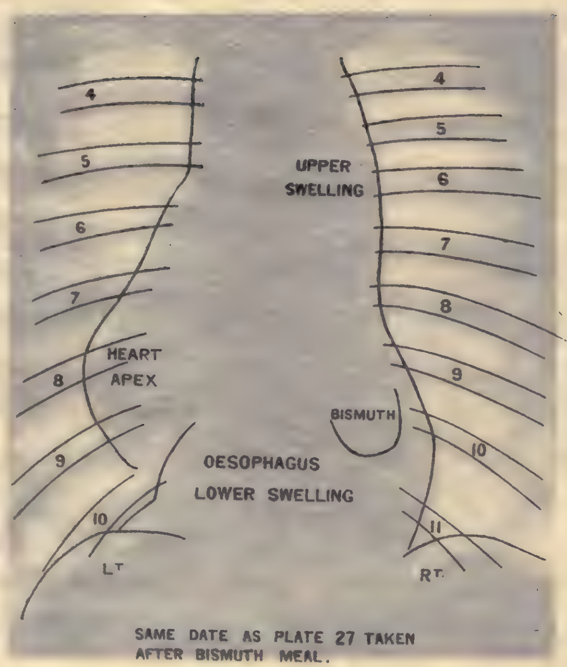
Plate 24.

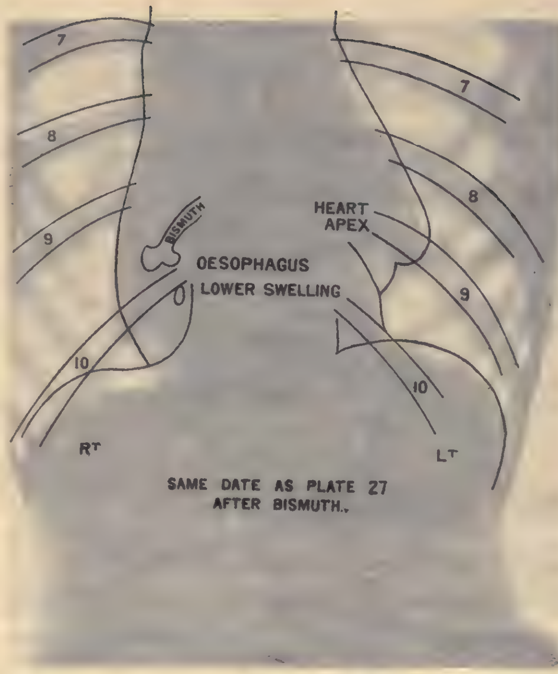
Plate 25.

Plate 26.

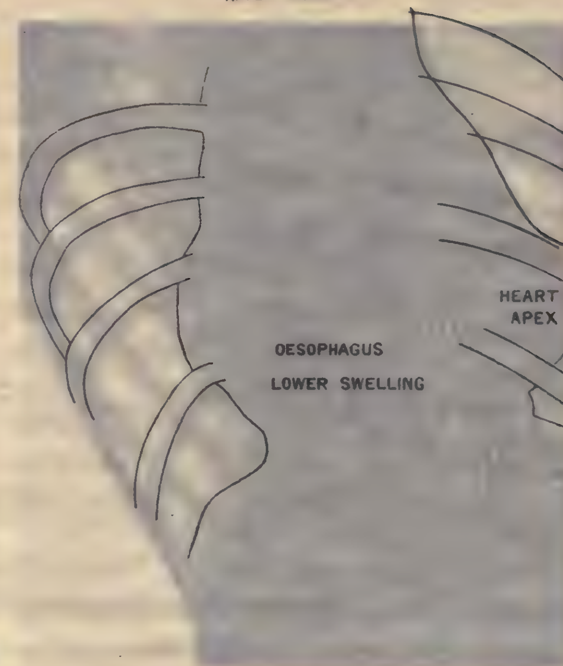
Plate 27.

Plate 19.





SAME DATE AS PLATE 27
AFTER BISMUTH.




SAME DATE AS PLATE 27
AFTER BISMUTH
HEART
APEX
OESOPHAGUS
LOWER SWELLING
HEART
APEX
OESOPHAGUS
LOWER SWELLING
BISMUTH
SAME DATE AS PLATE 27
AFTER BISMUTH.
UPPER -
SWELLING
BISMUTH
HEART
APEX
OESOPHAGUS
LOWER SWELLING
SAME DATE AS PLATE 27 TAKEN
AFTER BISMUTH MEAL.

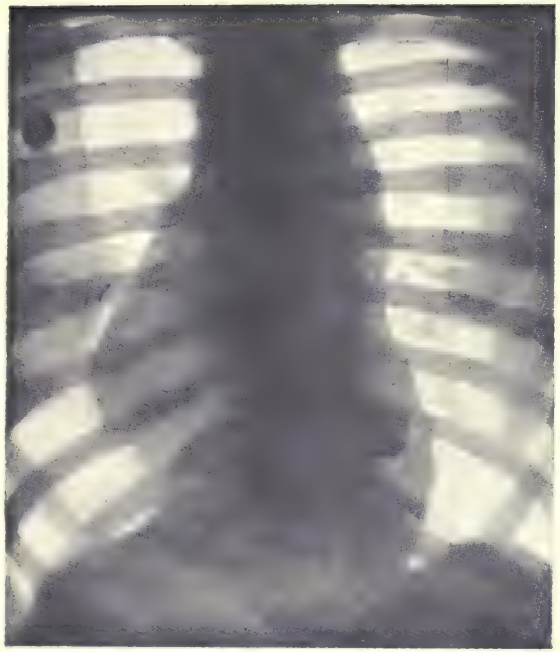


Plate 28.

Plate 29.

Plate 30.

Plate 20.

might occur night or day; she would wake up with dyspnœa and immediately vomit up frothy mucus. She lost 6 lb. in weight in two weeks.

Present condition (September 15, 1914). She was extremely wasted and fragile, but smiling and bright, and seemed to enjoy being examined. There was a slight but distinct stridor with inspiration, audible at a distance from her. She did not complain of any pain. No enlarged glands could be felt. Tongue clean; pharyngeal reflex present.

Chest. Some slightly impaired resonance over upper sternum in front; stridor distinct here. Behind, a patch of impaired resonance opposite

of our visit precluded a thorough investigation of what was obviously a very difficult and obscure case. The patient was not in bed and the examination had to be made on the drawing-room couch.

In discussing the diagnosis we naturally considered the possibility of a purely functional disorder. There were several things in favour of this: her sex and age, the delayed onset of menstruation, the fact that she was an only child who had always been delicate and spoiled, the distressing illness of her mother, the disappearance of dysphagia for sixteen months, followed by its recurrence. Nor was her general

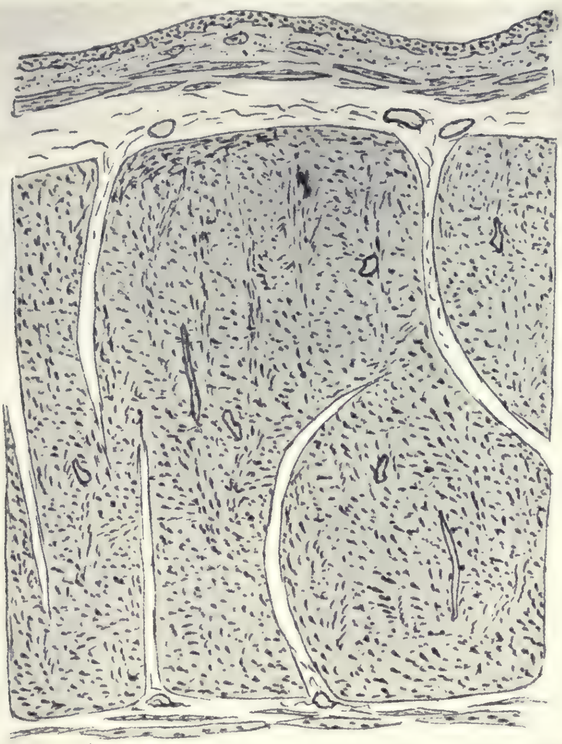


PLATE 31. FIG. 1. Œsophagus: transverse section of lateral wall at 7 cm. below cricoid. *a*, epithelium; *b*, mucosa; *c*, muscularis mucosæ; *d*, submucosa; *e*, hypertrophied circular muscle; *f*, longitudinal muscle. (× 10.)

middle of left scapula with broncho-vesicular breathing. Slight spinal curvature lateral—mid-dorsal.

Abdomen not hollowed, no enlarged organs. Legs wasted. K.-j. sluggish. Urine 1·012, no albumin, no sugar.

She was given water in our presence and swallowed it, in sips, without difficulty. Given a biscuit, she ate it slowly, but seemed to swallow it quite well, with no "hawking."

After leaving the room, a few minutes later, she coughed or "vomited" (?) one or two ounces of mucus and brownish material.

I regret very deeply the scantiness of this record, but, as mentioned above, the conditions

appearance and behaviour altogether against such a view.

It was impossible to reconcile the apparently conflicting results of the two X-ray examinations.

If there was a shadow in the posterior mediastinum suggesting bronchial glands or an intrathoracic growth in March, 1913, why should the dysphagia and other symptoms disappear entirely until June, 1914; and why should their recurrence be associated not only with a stricture in the upper œsophagus, which might reasonably be due to the intrathoracic mass seen in March, 1913, but also with a shadow due to the bismuth meal collected just above the cardia?

The whole condition was so puzzling and con-

tradictory that we did not feel justified in forming any opinion until we had the opporunity of a thorough and complete investigation of the œsophagus by instrumental and X-ray methods.

In order that this might be done we advised that she should be removed to a private nursing home. This advice was, unfortunately, not followed. The mother died a few days later and the patient was sent away to the seaside in charge of a nurse. At this point my connection with the case, during life, ceases. I never saw her again until the autopsy. For the remainder of the history I am indebted to others.

Further history. She remained at the seaside from the end of September until the end of November, 1914. During this time she had no medical attention. The nurse in charge kept a daily record of the quantity of food taken, of material "brought up," of her weight, and so forth.

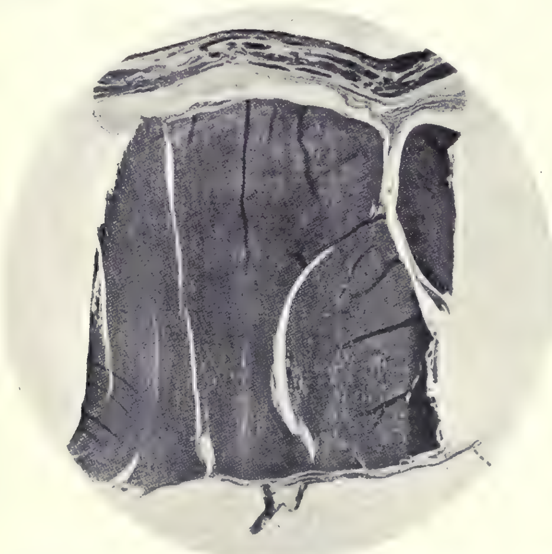


PLATE 31. FIG. 2. Section of œsophagus from upper swelling. *a*, mucosa; *b*, submucosa; *c*, circular muscular coat; *d*, longitudinal muscular coat. (× 8 diam.)

From these records it is evident that although the dysphagia continued she was able to take sufficient nourishment to prevent any great loss of flesh. For some weeks her weight remained at about 5 st. 6 lb.—once it actually rose to 5 st. 8 lb., and at the end of her stay she had only lost 5 lb. "Vomiting" occurred regularly each night, the quantity varying from 1 to 12 (or more) oz., the material being of a creamy colour and not containing any food; during the day she sometimes did not "vomit" at all, and when she did the quantity was usually rather less than in the night. It is described as of similar consistence and colour, and usually contained no food.

Towards the end of this period the nurse distinguishes in the records between "expectoration" and "vomit," but apparently the material brought up and measured by the former method was identical with that previously described as "vomit" and was merely brought up with less effort.

On a few occasions only the bringing up of this material was accompanied by pain, and once or twice food came with it. During the last week of her stay at the seaside the quantities brought up increased both day and night, averaging 15 to 26 oz. in the twenty-four hours.

At the end of November, 1914, she was removed to London and was under the care of Dr. Bourns of South Kensington, who writes as follows: "Sometimes while still taking food it would be returned, at other times it was kept down for as much as two hours. Only fluids or such things as thin corn-flour were attempted, and always the vomited food was churned up and frothy in appearance. The effort made at the moment of returning food suggested to me that it was not vomiting in the usual sense, but rather a regurgitation."

In December she was X-rayed by Dr. Robert Knox, who has kindly allowed me to have prints of the results. Very large and definite shadows were found in the chest.

Owing to the increasing dysphagia during December, feeding by rectal enemata was begun, and during the last six weeks of her life she was unable to swallow anything.

She was brought back to Sheffield shortly before her death, which occurred on January 19, 1915.

Permission was given for an autopsy which, with the assistance of Dr. Mylan, I made on the evening of her death.

Autopsy. January 19, 1915. The cadaver was an absolute "skeleton"; the tissues quite dry and almost bloodless.

On opening the thorax and removing the heart and lungs an elongated smooth rounded mass was seen occupying the whole length of the posterior mediastinum.

At first sight its nature seemed doubtful, the lower third being swollen out into a rounded, hard tumour-like mass (Plate 24). Further examination showed that it was continuous with the very small pharynx above and the small stomach below, and that it was the greatly enlarged œsophagus. It appeared to be distended with food, but this explanation seemed quite impossible as she had taken nothing by the mouth for six weeks before death. It was decided to fix the specimen in formalin solution before making any further examination.

As regards the other organs nothing abnormal was found except some infarcts in the lungs, and the general appearances associated with profound wasting.

I regret now that a more careful examination was not made of the whole intestinal canal, but so far as was seen there was no marked abnormality.

Description of œsophagus, naked eye. For purposes of description it may be divided into two parts (Plate 24): the upper and narrower, which runs vertically and ends rather more than half way down in a somewhat constricted "neck," and the lower and much thicker portion, which runs obliquely to the left, passes through the diaphragm, and joins the cardia of the stomach.

PLATE 31. FIG. 3. Normal œsophagus. *a*, external coat; *b*, longitudinal muscle; *c*, circular muscle; *d*, submucosa; *e*, muscularis mucosæ; *f*, mucosa; *g*, epithelium.

Reproduced by permission of Messrs. Longmans, Green & Co., from Quain's *Anatomy*, vol. iii, part iv, Fig. 83.

The surface throughout is smooth and covered with thin connective tissue—there are no adhesions to neighbouring organs and there is no evidence of any inflammatory changes in its neighbourhood. It is remarkably firm and hard.

The greatest circumference is in the lower half (22 cm.), whilst at the point where it passes through the diaphragm it measures 15 cm.

The pharynx and top of the œsophagus are particularly small and the walls are extremely thin; in the hardened specimen the lumen barely admits an ordinary lead pencil.

The thickening of the wall begins somewhat abruptly. Its highest point is posteriorly where it reaches to a point 3 cm. from the cricoid. The sides of the tube are also thickened to almost the same height, but at the front of the tube, where it is in contact with the trachea, the thickening is entirely absent until a point 6 cm. below the cricoid. This open-fronted collar-like arrangement of the hypertrophied muscle is shown in Plate 24. The amount of thickening is least at the upper end and steadily increases downwards.

In this upper part it is in the form of rings due to furrows running an obliquely transverse course, upwards and to the left in front, downwards and to the right behind (Plate 24).

The tube rapidly gets thicker, and just below the bifurcation of the trachea it has become a very hard cartilage-like mass with a circumference of 17 cm. at the widest part of the upper half.

The circumference of what will be referred to throughout as "the upper swelling" remains much the same for a considerable distance, but ends in a slight constriction or "neck" at a point 18·5 cm. below the cricoid. This "neck" measures about 14 cm. in circumference.

Immediately below the "neck" the œsophagus widens out rapidly into a large rounded mass measuring 21·5 cm. in circumference at its thickest part. It is hard and firm, smooth, with no adhesions or inflammatory changes. Longitudinally running fibres are seen on the surface (Plate 24). In the lower part where the thickness is getting less a line is seen running obliquely across. This is the level of the diaphragm. A small portion of the diaphragm remains attached to the left end of this line. Below the diaphragm the thickness gradually lessens until the cardiac stomach begins almost imperceptibly.

As will be described more fully later, the hypertrophied muscular coat projects as wedges into the anterior and posterior walls of the stomach for about 3 cm. The left edge of the anterior portion can be seen as an oblique vertical line just opposite the middle of the spleen (Plate 24).

The stomach is small and except at the cardiac end appears normal as regards musculature and mucosa.

On cutting into the stomach and passing a finger up to the cardia, the opening was found

to have the form of a transverse slit with the two projecting wedges of the thickened muscular tissue in front and behind respectively. It felt very much like a normal multiparous os uteri.

The œsophagus was laid open by a coronal section from right to left (Plate 25). The walls are seen to be extremely thickened by an overgrowth of dense tissue extending the whole length of the tube. The growth is divided up into lobules and bundles by fibrous septa, and to the naked eye closely resembles the appearance of a section of fibromyoma of the uterus.

The actual amount of thickening of the wall varies considerably at different levels from above downwards, and also at different parts of the circumference in a horizontal plane. Thus it is least at the extreme upper end, where it is unequally distributed, being thicker on the right side and behind than in front and on the left. In the plane of the section (Plate 25) the lumen disappears from sight for about 4 cm. in the middle of the upper swelling. It is situated in a plane nearer the posterior surface in the piece marked A (Plate 25). When laid open it is found to be somewhat narrower in the transverse diameter than the lumen immediately above and below, but the chief narrowing is in the antero-posterior diameter. This flattening has been produced by the backward pressure of the anterior wall, which at this point is very much thickened.

Below this narrowed portion of the lumen, the part which was described above as the neck is situated. Here the lumen widens out again and becomes more rounded in shape, owing to the thickness of the walls being more uniform. About 3 or 4 cm. lower, the large lower swelling is reached, and is seen to be made up of massive muscular walls having in places a thickness of almost 4 cm. The wall is thicker at the left and posteriorly. The lumen is here flattened out transversely, measuring 3 cm. in its widest part, but the anterior and posterior surfaces are almost in apposition. The mucosa is pushed up into rounded nodular swellings by the masses of muscular tissue, so that the surface, especially the posterior, has a mammillated appearance not unlike the surface of a cirrhotic liver. The lumen narrows down to 2 cm. at the cardiac orifice, which is situated nearer the right than the left border of the swelling. There is no appearance of stricture at the cardia. Immediately below the cardia and extending

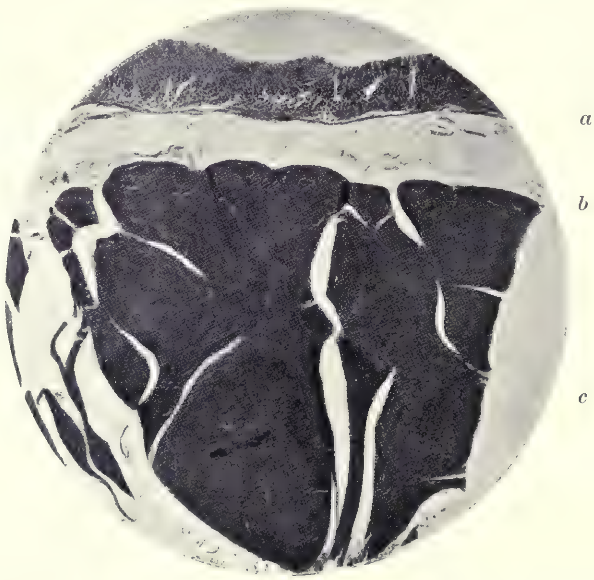


PLATE 32. FIG. 1. Section of cardiac stomach in region of fibromyomatous growth. *a*, mucosa ; *b*, submucosa ; *c*, muscularis. (× 8 diam.)

for 3·5 cm. into the stomach walls are two wedge-shaped prolongations of hypertrophied muscular tissue, one in the anterior, the other in the posterior wall. The mucosa over these is not thrown into rugæ, as it is in the surrounding parts of the stomach (Plate 25 (8); also Plate 32, Figs. 1 and 2).

The mucosa of the œsophagus is smooth and glistening in all parts. There is some evident congestion in the upper and middle parts (Plate 31, Fig. 2), but nowhere is there any sign of erosion or ulceration, nor are there any rugæ or irregularities except those described already in the lower part.

Measurements of Œsophagus.

	cm.
From cricoid to diaphragm	26·0
From cricoid to upper level of hypertrophy in—	
Anterior wall	6·0
Posterior wall	2·5
From cricoid to lower end of upper swelling (neck)	18·5
From diaphragm to lowest point of hypertrophied muscle in stomach wall—anteriorly	6·0
From cardia to lowest point of hypertrophied muscle in stomach	3·0
Greatest circumference of lower swelling	21·5
Greatest circumference of upper swelling	17·0
Greatest diameter of wall in lower swelling, nearly	4·0
Cavities:	
Diameter of lower cavity in widest part (side to side)	3·0
Diameter of cardia side to side	2·0
Length of the constriction in upper swelling	3·5

Looking back, it is obvious that with no previous experience of a similar condition as a guide an exact diagnosis during life was not to be expected.

For my own part, the brief single examination of the case in June, 1914, without having at that time seen any radiograms of the chest, and under the restricted circumstances mentioned in the history above, inclined me to the view of a purely hysterical condition or a possible "achalasia."

When the shadow was found by the X rays in Ireland, in 1913, a mediastinal growth was quite reasonably suspected, and putting everything together tubercular glands were thought the most probable condition.

In the second examinations by X rays the existence of the stricture high up was noted, but the lower shadow was naturally thought to be a dilated œsophagus containing the bismuth meal.

At a still later stage, in the excellent radiograms taken by Dr. R. Knox (Plates 27-30), the patient was so ill and able to take so little bismuth food that an exact interpretation was impossible.

In a letter to me Dr. Knox writes:

"I looked upon the case as one of dilatation of the œsophagus attended by a degree of hypertrophy. Unfortunately the patient could only take a spoonful or two of the bismuth food, so it did not show the size of the œsophagus at all well. The examination was incomplete on account of the difficulty the patient had in taking food. . . .

"She was screened while taking the food, but it was so little that no conclusions could be drawn from the examination. The small quantity travelled very slowly down to the right side of the thorax."

Interpreted by the condition found at autopsy, Plate 27 (taken in December, 1914, by Dr. Knox, before the bismuth meal) shows (i) the upper swelling of the œsophagus bulging to the right opposite the fourth, fifth, and sixth ribs, (ii) the narrower lower end of this opposite the seventh rib, (iii) the lower swelling both to the right and left of the vertebral column, (iv) the heart's apex lifted up and separated from the diaphragm by a clear space.

Plate 29, taken after the bismuth meal, shows very beautifully the small quantities of bismuth forming irregular shadows in the lumen of the lower swelling, seen in the right ninth and tenth intercostal spaces. These darker shadows give a very clear idea of the relative proportion of dilatation to hypertrophy. The upper irregular one is continuous

upwards with a dark shadow of larger size opposite the eighth interspace, which is probably bismuth collected in the more circular lumen corresponding with the "neck" (Plate 25 (6)).

Histological Examination. — The appearance of the thickened walls to the naked eye suggests that seen in the typical "fibromyoma" of the uterus. This is due to the lobulated masses separated by connective-tissue septa, with fibres running in various directions and forming irregular whorls, particularly seen in the thickest parts of the upper and lower swellings.

Microscopic examination confirms this similarity. A section taken through the upper part just above the constriction of the lumen shows that the whole increased thickness is due to excessive myomatous overgrowth, which occupies the position of the internal circular muscular coat (Plate 31, Fig. 1; also Plate 31, Fig. 2). The epithelium is normal in appearance (Plate 31, Fig. 1, *a*); the mucosa shows extreme congestion of vessels and here and there some small round-celled infiltration (Plate 31, Fig. 1, *b*); the muscularis mucosæ and submucous coats appear normal (*c* and *d*).

The circular muscular coat, which is normally rather narrower than the longitudinal, here overshadows everything else, although the point at which this section is taken is one of the thinner parts of the wall. The muscular fibres are entirely non-striated. This is a point of some interest which will be referred to later. They do not all run circularly; many bundles run in a horizontal plane from the external wall towards the lumen, whilst other bundles take a slanting course so as to have in many places a pennate arrangement. Sometimes the bundles alternate in direction in a surprisingly regular manner, groups of circular ones being separated from each other by horizontal pin-like bundles. From relative quantities of cell substance and nuclei, it seems evident that there is a considerable amount of supporting material binding together the muscular fibres, although it is difficult, as in fibromyoma of the uterus, always to distinguish which is which. The tissue is divided into larger lobules by well-marked connective-tissue septa which contain blood-vessels. Numerous blood-vessels are also seen in the lobules of muscular tissue themselves. Outside this abnormal circular

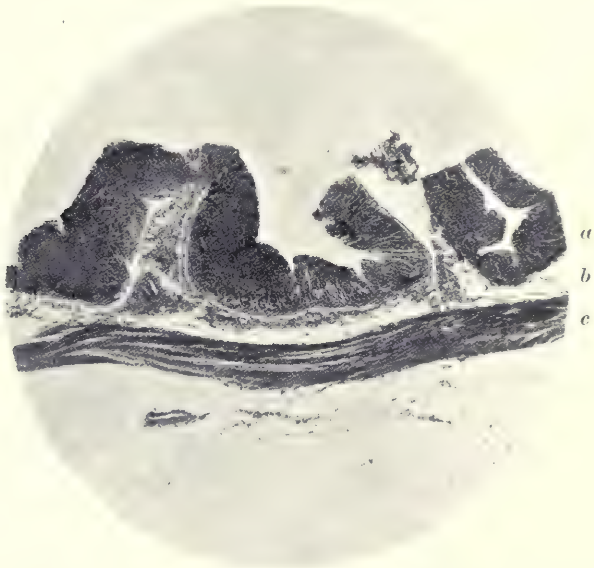


PLATE 32. FIG. 2. Section of cardiac stomach just below region of growth. *a*, mucosa; *b*, submucosa; *c*, muscularis. (× 8 diam.) Note difference of thickness of muscularis in the two sections and absence of folding of mucosa in Fig. 1.

muscular coat, a thin layer of longitudinal fibres is seen. This layer is here not thicker than the muscularis mucosæ, and consists also of non-striated cells only.

Section through the very thick muscular mass in the lower swelling shows similar appearances, but the fibres here run in more irregularly directed bundles. In many parts it appears as though the muscular fibres had degenerated, atrophied, and disappeared, leaving only a fenestrated supporting tissue, with branching processes joining it together. A section through the wedge-like process in the upper part of the stomach shows a normal gastric mucosa with peptic glands, a normal mucosa, and the underlying mass of fibromyomatous tissue replacing the circular coat as in the œsophagus (Plate 32, Fig. 1).

So far as the above sections are concerned the findings are definite and simple. Sections taken, however, through the upper part of the upper swelling (Plate 25) at and around the site of the hæmorrhages seen there show changes which have been somewhat difficult to interpret.

The mucous and submucous coats are normal, as in the previously described sections from other parts. The mass of abnormal growth still limits itself entirely to the site of the circular muscular coat, but its character has undergone considerable changes.

In places there is effusion of blood into the tissues. In general characters it still consists of fibromyomatous tissue, but the typical unstriped muscular fibres are less closely packed, their outline is less clearly marked, and the number of nuclei visible in any field is diminished. Here and there are seen rounded bodies of larger size looking with a low magnification like large round cells or striated muscular fibres cut across. On examination with higher powers these round bodies are seen not to be normal cells. Most of them show no nucleus, whilst a few show a nucleus of relatively small size, such as that of an unstriped fibre cut across, usually excentrically placed.

That these rounded bodies are really cross-sections of some kind of elongated cell or fibre is seen when they are cut obliquely or longitudinally. They have then a somewhat curious fusiform outline, and are not of regular contour, but are swollen in the more central parts. The swelling is usually spherical and causes the fibre to bulge out; it stains with the same dye as the rest of the fibre, but is somewhat deeper in colour. It is also more dense in structure than the rest of the fibre.

Most of these swollen fibres appear to have no nucleus; in some there is an elongated nucleus similar to that of an unstriped muscle cell. In some the cell ends in an ill-defined branching process.

It seems clear that the round bodies previously described are really transverse sections of these swellings in the fibres.

Professor J. S. C. Douglas, who has kindly looked over these sections for me, thinks that the changes here described are probably degenerative in nature, and that they may be a condition occurring in unstriped muscle, not altogether dissimilar from Zenker's degeneration in striped muscle.

This curious histological appearance, found only at one part of the specimen, presents some interest in connection with the question of a possible sarcomatous development in the myomatous tissue, and will be referred to later.

(To be continued.)

REVIEWS.

Notes on Galvanism and Faradism. By E. M. MAGILL, M.B., B.S. Lond. Pages xvi. + 220. Crown 8vo. Price 4s. 6d. net. H. K. Lewis & Co., Ltd., London.

This book has been written for the use of masseuses preparing for the examination in Medical Electricity held by the Incorporated Society of Trained Masseuses. It is divided into three parts. The first part deals with galvanism. After a short preliminary note on the physical aspect of medical electricity,

a description is given of galvanic cells and medical batteries and electrodes. The uses of the galvanic current for the treatment of various morbid conditions, and for carrying out ionic medication are described. A chapter on electrolytic burns is given and another on the action of the galvanic current on muscles. The second part is devoted to the medical uses of the faradic current. The principles of induction and the structure and mode of working of the coil are described. The methods of applying the faradic current to the body and the medical uses of this current are set forth.

The third part deals with the currents from the main, how they may be utilised for medical electrical purposes and the attendant dangers. A chapter on radiant heat and light has been added. Two appendices conclude the book. In one of these is given a list of maladies, each with the electrical treatment advised. This is for the guidance of the masseuse when she is requested to apply electrical treatment and no prescription is given by the doctor. The syllabus of the examination in medical electricity held by the Incorporated Society of Trained Masseuses, and specimen questions set in past examinations will be found.

The authoress of this book has given good descriptions of the electrical apparatus, and the instructions for the electrical treatment of the patient are clearly set forth. Objection must be made to the statement on p. 130 that the "faradic current exerts its effect on muscular tissue only through the nerves," as the discharges of most medical coils are long enough to stimulate muscle fibres directly. The explanation of the way in which electrolytic burns are produced (p. 93) is difficult to follow. The explanation of the twitch of the frog's muscles in Galvani's experiment (p. 25), viz., that the dissimilar metals and the acids in the muscles form a cell and currents are produced and stimulate the muscles, fails because the muscles are stated to be dead.

The book will be found a useful guide for the masseuse who requires practical instruction in the simpler application of faradism and galvanism for medical purposes. It is well got up and there is a good index.

The American Atlas of Stereoroentgenography. Edited and published under the sole auspices of the New York Roentgen Society. Editors, Leopold Jaches, M.D., Walter H. Stewart, H. M. Imboden. With associates and correspondents throughout the world. The Southworth Company, Troy, New York.

The scope of this work if carried out to its fullest extent is very comprehensive. "Clinical in its broadest sense, elucidating Anatomy, Physiology, Morphology, Organology, and Pathology in the living subject in a more practical and graphic manner than ever before attempted."

It is the outcome of a desire on the part of prominent radiographers to present to the medical public a graphic representation of the aid that can be rendered in diagnosis by means of stereoscopic radiograms of typical and interesting cases. The value of stereoscopic radiography has been well indicated by the pioneer work of Sir James MacKenzie Davidson on this side of the Atlantic, and its inestimable value in the radiography of war has been seen over and over again, and proved by numbers of workers during the past two years. There can be no doubt that when once the value of stereoscopic work in radiography is fully realised the demand for it will increase, and that the more rapidly when practising physicians and surgeons grasp its value in the interpretation of the cases with which they have to deal.

When the time comes for the universal adoption of stereoscopic radiography the educational value of such a work as the one at present under review will be very great.

The quarterly appearance of a number of interesting radiograms will be welcomed by all who are engaged in this work; they in turn will no doubt contribute of their best.

The editors and publishers evidently feel that this will in time eventuate, for they state that the editors are associated with correspondents throughout the world.

With so far reaching a connection the work must be successful, and should prove, as it is evidently intended to do, a most useful addition to the libraries of all interested in practical medicine and surgery.

The clinical side receives a full measure of attention; it is a useful atlas, and in time will become an encyclopædia. We cordially welcome the first instalment of this budding encyclopædia and wish it the success it deserves.

The first number is, as would be expected, largely explanatory in character, the first section being devoted to a publisher's announcement laying forth the objects to be achieved.

A short chapter by Dr. Caldwell, of New York, entitled, "Why the Stereoscope?" explains why the stereoscopic picture is required in radiography. A historical résumé of the steps which have led to the present day procedure is interesting.

The next section deals with stereoscopic dental röntgenography, by Dr. George M. Mackee. The necessary technique is described. It is characterised by a simplicity, the reason for which is obvious when we consider the limited space available in the average mouth for the insertion of film changers. Possibly a more complete technique may be evolved in the course of time. It is illustrated by a very good example of dental radiography.

An interesting case of fracture of the skull is next dealt with. Tumour of the brain is illustrated by good stereoroentgenograms; the clinical and operative history is briefly given. Then follow cases of diverticula of the œsophagus, congenital stricture of the œsophagus.

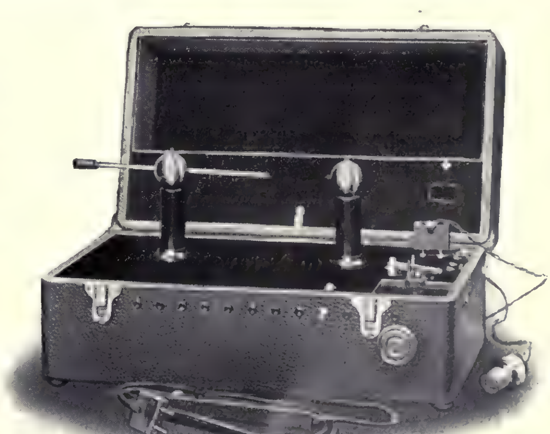
"Multiple Diverticula of the Colon," by Dr. James T. Case. This is a beautiful example of Dr. Case's work, and is fully described in an admirable dissertation on the pathology and the clinical signs and radiographic interpretation. This section is the best in the book and should be taken as a model for future papers.

The remaining illustrations include an interesting case of comminuted fracture of the right elbow; chronic appendicitis, showing the appendix filled with the opaque food; stone in redundant ureter, showing the stone encircled by the opaque catheter. Finally, there is a short account of a case of thymus death, where the thymus gland is shown to be enlarged.

We commend these publications to all who are interested in the diagnostic side of radiography and await with interest the future numbers. The formation of the publication leaves nothing to be desired.

NEW INSTRUMENT.

A NOVEL X-RAY OUTFIT.



Apparatus for the application of the Roentgen rays has now been in use professionally for twenty years. As time has progressed, experience and practice have led to various improvements in design, both of the apparatus itself and its accessories. Coils have been wound in a lesser or greater number of sections, insulation between windings has been improved, many ingenious devices, such as those tending to minimise the likelihood of shock to the operator, from the thin wires connecting the tubes, are probably familiar to most of our readers.

It is gratifying also to record the tendency, increasingly noticeable of late years, of manufacturers to take note of drawbacks believed to be incidental to the construction of this or that piece of apparatus, and then concentrating their abilities and ingenuity upon the elimination of those drawbacks.

The illustration shows the "Dubilier" X-ray outfit, a well made apparatus emanating

from The General Electric Company, Limited, of London, who were among the first makers to enter the field with English-made electro-therapeutic appliances, many years ago.

This apparatus was recently demonstrated to an audience at a conversazione, arranged by the Roentgen Society, and its salient features and advantages were explained—these may be summarised as follows:—

1. The apparatus derives its current from any electric light main, being attached by the usual plug-adapter to any convenient lamp socket.

The primary battery or accumulator difficulty is, therefore, non-existent.

2. The apparatus can be used on any voltage from 55 to 250. A simple device enables a small alteration to be made for the higher voltages. Instructions are sent out with each apparatus, explaining clearly how this can be done. It can also be used equally well on alternating or continuous current circuits.

3. *Adaptability.*—The apparatus is adaptable for X-ray work, and an ingenious device enables it also to be used for high-frequency work, dental purposes, etc., as well as cautery. Regulators are provided for increasing or decreasing the current at will.

4. *Portability.*—This is one of the chief advantages of the apparatus, because the outfit for use with a 5 in. tube measures only 16 in. by 9 in. by 7 in. and weighs only 28 lb., whilst the large apparatus (giving quicker and deeper penetration) measures 24 in. by 10 in. by 7½ in. and weighs 43 lb.

It will, therefore, be seen that the apparatus can readily be taken from place to place and can be used by any practitioner, either in his consulting room or equally well at the house of the patient, nursing home, local hospital, etc.

The foregoing remarks refer to the apparatus itself. Special safety devices can be attached to it and the usual accessories for radiographic work. The "Dubilier" outfit merely comprises the apparatus for the production of the X rays. The tubes, tube-holders, safety screens, etc., can be those ordinarily used, procurable through the usual medical wholesalers.

NOTES AND ABSTRACTS.

RADIOTHERAPY.

X-Ray Protection.—*Bull. et mém. de la Soc. de Chir.*, No. 34, page 1957.—Mauclair states that he is accustomed frequently to undertake the extraction of metallic foreign bodies in darkness, under the control of the screen, and that the great objection to this method is that the hands of the operator are too much exposed to X rays. Some surgeons operate with bent forceps, so that the hands are outside the beam, but this is not very convenient, and he prefers to go directly down upon the foreign body with straight forceps, the operation usually occupying no more than two or three minutes in the case of the limbs. In order to protect his hands, he has tried lead gloves, but found them too hard, and accordingly has made a solution of caoutchouc and bismuth or lead, which he applies on the inner surface of caoutchouc gloves, to the extent of four layers at least. Under this treatment the glove still remains supple. By way of extra precaution, he applies the same solution to his hands, both on the dorsal face and the palmar, the solution being removed very quickly afterwards with mineral essence, and the skin remaining unaltered and unirritated even in hairy hands. The composition of the solution is as follows:

Thick solution of caoutchouc (known in automobilism as the dissolution)	50 grams
Mineral essence (distillate of mineral oil)	50 grams
Carbonate of lead	100 grams

This is mixed with the aid of a mortar, and in order to secure a homogeneous paste, it is passed through a fine sieve of silk such as is used by painters. Each layer dries in half an hour, and four successive layers are given.

The fingers are filled with an inert powder in order that they may not adhere and to facilitate the regular application of the protecting coat. The gloves thus covered are sterilized by being steeped for an hour in alcohol, which does not alter the coating. With the hand in this glove, held at 30 cm. from the tube, it is not possible to see the metacarpal bones. It is not claimed, however, that by this method the hands are completely protected, but the protection is sufficient, in the author's opinion, in view of the very great rapidity with which foreign bodies may be extracted under the control of the screen. The diaphragm which canalises the rays is narrowed as much as possible, and the hand with its protecting glove is only in the path of the rays for a very brief time. As to the patient, if the operation should be rather long, and in a special region such as the face, it might be useful to apply a layer of caoutchouc and lead solution outside the zone of the rays canalised by the diaphragm.

The Effect of Dehydration on Platinocyanide of Barium.—*Arch. d'électr. méd.*, June, 1916.—Nogier calls attention to the fact that the increasing vogue of systems of central heating, not only in hospitals and clinics, but even in private houses, may be a source of trouble to the radiologist. This system of heating rapidly induces a high degree of dryness in the atmosphere, and since it has been shown that the toning of platinocyanide of barium is due to the action of dehydration, the danger to the user of pastilles and screens is obvious. Such toning may be obtained in a condenser in which the air has been desiccated by sulphuric acid or chloride of calcium, even without any rise of temperature, and with such rise the action becomes much more rapid. The transformation of the green platinocyanide into the brown platinocyanide may be so complete that it becomes irreversible and permanently non-fluorescent. This toning of the platinocyanide by dehydration may be produced very easily in air desiccated by central heating. The author has observed a number of Sabouraud pastilles, a screen of platinocyanide of barium, and the standard tint of two chromoradiometers of Bordier change in a night in a definite manner under this influence. One should be careful, therefore, never to leave in a room warmed by hot air, vapour, or hot water, either screens of platinocyanide of barium or the pastilles of Sabouraud or Bordier. If it is not possible to make other arrangements, or adopt a different method of heating, one may evade these accidents by causing water to evaporate in the rooms thus heated and so modify the hygrometric condition of the air.

CORRESPONDENCE.

To the Editors of Archives of Radiology and Electrotherapy.

101, Rokkosan, Kobe.
28th July, 1916.

Dear Sirs,

If the "Notes, etc.," I sent in June last to the above Journal have not yet been published, there might be appended to them the accompanying note :—

To the above cases have to be added three others, examined in June, two of which furnished positive results.

Case 30.—A lady of 27, weighing 164 lbs., had five attacks of biliary colic in five years, and furnished a questionable shadow with mottling, reported as "possibly caused by a gall bladder containing stones."

Case 31.—A man of 51, weighing 160 lbs., had several years of digestive disturbance, without colic. A radiograph gave a large, well marked shadow, in which a smaller, blurred-edged one was seen. "An enlarged gall bladder, probably containing multiple stones," was reported. A few days later Dr. Billinghurst removed an enlarged thick-walled bladder containing a number of small stones, so distributed and embedded in the wall that they could not have caused the smaller shadow obviously due to a local thickening of the generally thickened wall.

Thus, of 32 cases examined in all, nineteen cases were with positive radiological results

= 59·37 per cent.; ten of these nineteen cases were operated on = 31·28 per cent.; all of these confirmed.

Of these ten, calculi were found in six = 18·77 per cent.; enlarged gall bladder in four = 12·51 per cent.; and one of these four had also stones which were not detected in the radiograph.

Yours very truly,

N. MACLEOD.

PUBLICATIONS RECEIVED.

Books.

Diseases of Children. By A. DINGWALL FORDYCE, M.D. A. & C. Black.

Fractures. By J. B. ROBERTS, M.D., F.A.C.S., and JAMES A. KELLY, A.M., M.D. J. B. Lippincott Co.

Fractures and Dislocations, Diagnosis and Treatment. By MILLER E. PRESTON, A.B., M.D. C. V. Mosby Co., St. Louis.

Text-book of Operative Dentistry. By C. N. JOHNSON, M.A., L.D.S., D.D.S. William Heinemann.

Treatment of Diseases of the Skin. By W. K. SIBLEY, M.A., M.D. Edward Arnold.

X-ray Examination of the Chest for Pulmonary Tuberculosis. By KENNON DUNHAM, M.D. The Southworth Co., Troy.

Journals.

American Journal of Roentgenology, Aug. 1916.

American Medicine, Aug. 1916.

Archives d'Electricité Médicale et de Physiothérapie, Sept. 1916.

Archives de Médicine et de Pharmacie militaires, July, 1916.

Boston Medical and Surgical Journal, Aug. 31st, Sept. 7th and 14th, 1916.

Bulletin of the Johns Hopkins Hospital, Sept., 1916.

Cleveland Medical Journal, July, 1916.

Gaceta Medica Catalana, Aug. 15th, 31st, Sept. 15th, 1916.

Good Health, Sept., 1916.

Journal of Cutaneous Diseases, Sept., 1916.

Journal de Radiologie et d'Electrologie, July-Aug., 1916.

Maryland Medical Journal, Sept., 1916.

Medical Journal of Australia, July 29th and August 5th, 1916.

Medical Record, Aug. 19th, 26th, Sept. 2nd, 9th, 1916.

Medical Times, Sept., 1916.

New Orleans Medical and Surgical Journal, Sept. 1916.

New York Medical Journal, Aug. 26th, 1916, Sept. *2nd*, *9th*, 1916.

Norsk Magazin for Lægevidenskaben, Sept., 1916.

Pacific Medical Journal, Sept., 1916.

Policlinico, Section of Medicine, Section of Surgery, Jan. to Aug., 1916.

Revista Española de Electrología y Radiología Médicas, June, 1916.

Southern Medical Journal, Sept., 1916.

Ugeskrift for Læger, Aug. 10-31, 1916.

Urologic and Cutaneous Review, Aug. 1916.

NOTICES.

ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY is published monthly.

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Contributors of original articles, whether illustrated or not, will be furnished with 50 reprints free of cost. All radiographs and photographs must be originals, and must not have been previously published.

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Annual Subscriptions, payable in advance, to members of recognised medical and scientific societies, 16/-, to non-members, 21/- ($5.00 Postal Union), including postage. Single copies 2/- (postage 2d.) Single numbers and back numbers can be supplied on application.

Vol. XXI—No. 6 NOVEMBER, 1916 No. 196

ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

THE ACCURATE RADIOGRAPHY OF THE PITUITARY FOSSA AND OF THE SPHENOIDAL SINUSES.

By H. Trevelyan George, M.A. (Cantab.), M.R.C.S., L.R.C.P.
Clinical Assistant, X-ray Department, St. Bartholomew's Hospital.

The little device described in this article is one for ensuring a true lateral view of the head, or in other words, for ensuring that the median sagittal plane of the head shall be accurately perpendicular to the vertical line drawn through the focal point on the anticathode.

In the great majority of cases where a lateral view of the head is desired, this degree of accuracy is, of course, not required, but in at least one case, viz., the radiography of the pituitary fossa, and perhaps that of the sphenoidal sinuses may be added, it is of the greatest importance that we should obtain this true lateral view. If, for example, the view of the pituitary fossa be not a strictly lateral one, one side of the floor of the fossa will in the skiagram project upwards beyond the other side, and any measurements of the depth of the fossa made under these circumstances will necessarily be inaccurate.

As the device is only a modification of Captain Finzi's well-known method of coins in the ears, this method will be briefly described first, and then the modifications adopted by the writer will be more fully described.

In Finzi's method, one coin is placed in each auricle over the external auditory meatus, and is fixed there if necessary by pieces of strapping. Coins of any suitable size may be used, farthings or sixpences or even half-sovereigns, but as patients occasionally show a tendency to stray out of the X-ray room with the coins still in their ears, it is perhaps not quite advisable to use the latter coin.

The head is then placed "by eye" in an approximately lateral position and screened. The shadows of the two coins are brought into coincidence by manipulation of the head, and when this has been accomplished we know that we have, very nearly indeed, a true lateral view of the head, with the central ray passing through corresponding points on the two sides of the head, these points being very near to the central point of the external auditory meatus on each side.

There is one objection, however, to this method, and this is the obvious one that the lower coin (assuming the tube to be beneath the table) will cast a larger shadow on the screen than the upper one, and therefore, as both coins are opaque, it is not possible to say when the smaller shadow is exactly in the centre of the larger one, as it should be if the view of the head is to be a strictly lateral one.

To obviate this defect, instead of the *lower* coin (again assuming the tube to be below the table), the writer uses a lead ring. This is very simply made by describing two concentric circles on a piece of thick sheet lead and cutting away the superfluous lead. Exact measurements are not essential as ears differ much in size, but a convenient size is obtained by making AB equal to 20 mm., and CD to 14 mm (see Fig. 1), and a convenient thickness of sheet

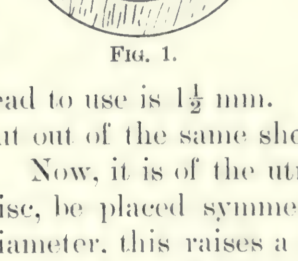


FIG. 1.

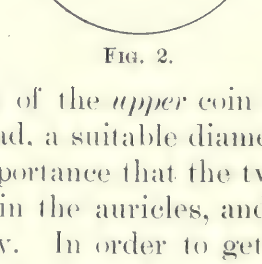


FIG. 2.

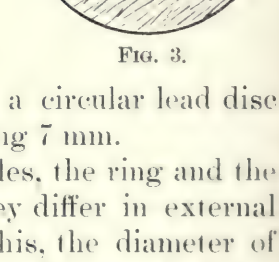


FIG. 3.

lead to use is $1\frac{1}{2}$ mm. Instead of the *upper* coin is used a circular lead disc cut out of the same sheet of lead, a suitable diameter being 7 mm.

Now, it is of the utmost importance that the two articles, the ring and the disc, be placed symmetrically in the auricles, and as they differ in external diameter, this raises a difficulty. In order to get over this, the diameter of the disc is artificially increased to that of the ring, *i.e.*, to AB, by embedding it in a circular hole of the proper size cut in a piece of cardboard of about the same thickness as that of the lead, and trimming the cardboard to the

Fig. 4.—HUMAN HEAD.

Fig. 7.—DRIED SKULL.

Usual appearance when the head has been set "by eye" alone.

Fig. 5.—HUMAN HEAD.

Fig. 8.—DRIED SKULL.

Appearance when a true lateral position of the head has been obtained and when the tube has been centred below the ring and disc.

Fig. 6.—HUMAN HEAD.

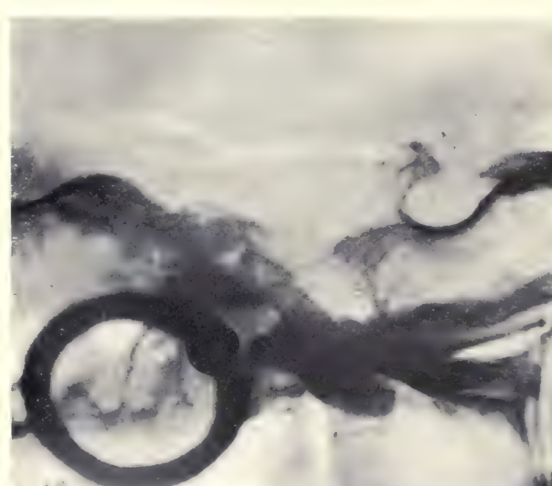


Fig. 9.—DRIED SKULL.

Appearance when a true lateral position of the head has been obtained and when the tube has been centred below the Pituitary Fossa.

Plate 21.

necessary size and shape (see Fig. 2). To keep the disc firmly in its place within the cardboard, two circular discs of thinner cardboard are cut with diameters equal to AB, and cemented with glue or seccotine one on each side of the compound disc of lead and cardboard. The result is a disc which looks as if it were made entirely of cardboard, but which really contains the lead disc embedded in a central position in it. Wood or other partially transparent materials can of course be used instead of the cardboard. A coating of "new skin" renders the disc waterproof, and it can then be washed after each case.

It will be noticed that the method depends upon the assumption that the auricles themselves are symmetrically placed in regard to the skull, and are of equal size. This assumption is probably correct in the great majority of cases, at all events to the degree of accuracy required.

Assuming the X-ray tube to be situated under the table, the lead ring is placed in the lower auricle, the compound disc in the upper auricle, and both fixed in their places if necessary by strapping. The head is then placed "by eye" in an approximately lateral position and screened. In general, the two shadows will not be concentric. The head is then manipulated until the shadow of the disc is seen to be in the centre of the transparent area bounded externally by the shadow of the lead ring (see Fig. 3). An air cushion placed under the head will be found useful in obtaining the correct position.

It is hardly necessary to say that in these manipulations the tube should be "centred" in regard to the ring and disc, exactly as in the case of the localization of a foreign body.

We now have a true lateral view of the head, and we also know that the vertical ray from the focal point of the anticathode passes through a definite point in each ear which is very near to the centre of the external auditory meatus.

The radiography of the pituitary fossa is then proceeded with in the usual manner by moving the tube 3 cm. forwards and $2\frac{1}{2}$ cm. upwards, or if the sphenoidal sinuses are to be taken, by moving the tube 3 cm. and 1 cm. respectively.

Figs. 4, 5, and 6 illustrate the various steps in the process. Fig. 4 shews the usual appearance on the screen when the manipulation of the head has been done entirely "by eye." The shadow of the disc is seen to be outside that of the ring, and both factors for the successful radiography of the pituitary fossa are absent, viz., a true lateral position of the head, and the "centring" of the tube vertically below the pituitary fossa. Accurate measurements of the fossa under these conditions are seen to be impossible.

In Fig. 5, the head has been manipulated so that the two shadows are now concentric, or very nearly so, but note that the shadow of the pituitary fossa is still imperfect, as only one of the two necessary factors has been obtained, viz., a true lateral position. Any measurements of the pituitary fossa made on such a skiagram would of course be inaccurate. The posterior and inferior walls of the fossa are seen fairly clearly, but the anterior wall is not definite and distinc

In Fig. 6, the tube has been moved forwards and upwards the proper distances, and we now obtain a clear-cut view of the pituitary fossa. Ignoring the clinoid processes, the wall of the fossa is seen to constitute about three-quarters of the circumference of a rough circle, and measurements of this can be made with accuracy and correctness. The skiagrams, of which Figs. 4, 5, and 6 are reproductions, shew these points clearly, but as it is possible that some of the delicate detail of the pituitary fossa may be lost in the reproduction, three corresponding skiagrams of the dried skull have been added for the sake of comparison. (See Figs. 7, 8 and 9).

The measurements of the fossa are usually stated in terms of the measurements of its shadow on the skiagram. The latter will of course be a little larger than the former, as the pituitary fossa is a little distance away from the plate, usually about three inches, but as the anticathode is usually at least a foot away from the nearest side of the face, the difference between the measurements of the fossa on the skiagram and the actual dimensions of the fossa itself will be small. In the case of the above distances, for example, the linear dimensions of the fossa itself will be five-sixths those of the shadow of the fossa on the skiagram. In any case, the measurements of the fossa can always be obtained from the measurements on the skiagram by a simple calculation similar to the above.

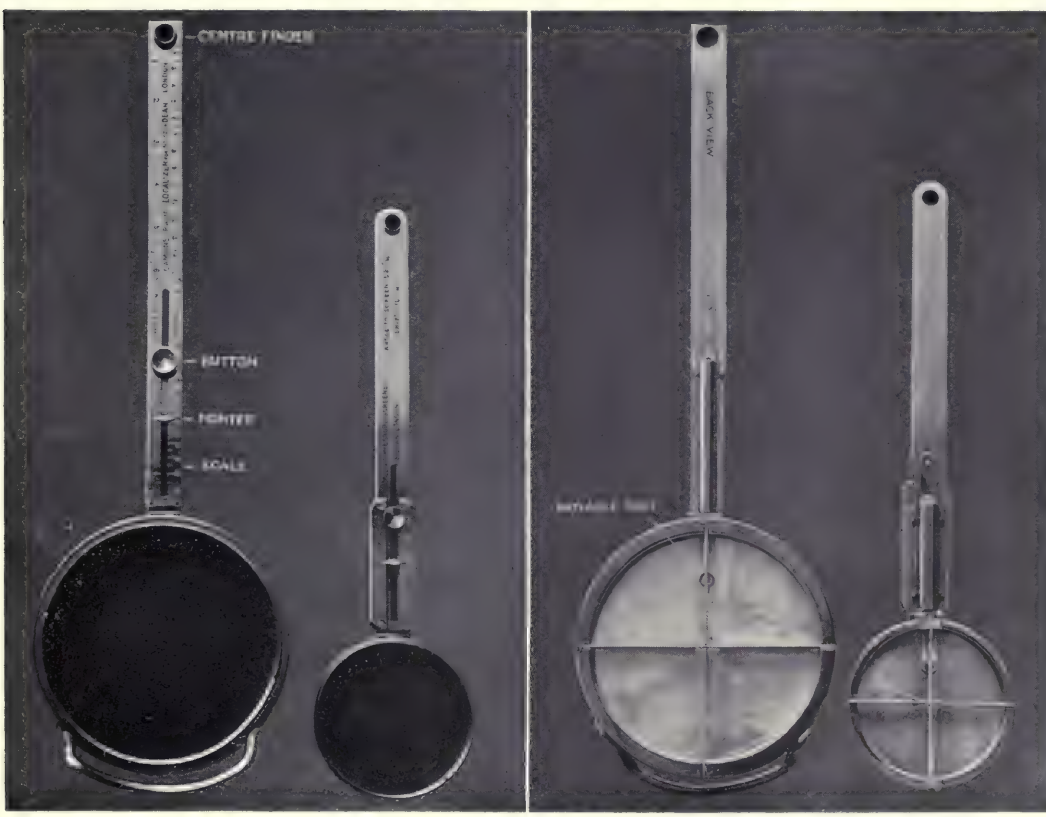
A great advantage of the method is that one can always check whether the manipulations have been carried out correctly. If they have, a straight line joining the centres of the ring and disc should, when produced, pass through the centre of the pituitary fossa. Moreover, since we may consider that there has been practically no displacement of the small disc, owing to its proximity to the plate, it is obvious that the length of this line should be equal to the square root of the sum of the squares of 3 and $2\frac{1}{2}$ cm., *i.e.*, very nearly 4 cm. In the original skiagram, of which Fig. 6 is a reproduction, both these conditions are satisfied.

The method described above is an exceedingly delicate one for obtaining the true lateral position of the head, as one will soon discover on trying it. The slightest movement of the head will throw the shadow of the disc away from the centre of that of the ring. Then, again, with modern X-ray couches, the tube can be moved the necessary distances upwards and forwards with great exactness, so that when we know more exactly than we do at present the amount of variation to expect in different normal heads, in the relative position of pituitary fossa and external auditory meatus, the exact radiography of the pituitary fossa should become an easy matter.

A SIMPLE, RAPID AND ACCURATE METHOD FOR LOCALIZATION OF FOREIGN BODIES SO AS TO INDICATE TO SURGEONS THE POSITION OF THE PATIENTS WHEN SKIAGRAPHED.

By Captain H. E. Gamlen, R.A.M.C.

Lately, during the battle periods, it has been found impossible to cope with the increased amount of work owing to the difficulty of obtaining plates, and the fact that the routine method of plating incurred delay. In consequence, it has been decided, with few exceptions, to screen the cases, and, where possible, to make examinations and report upon the presence and position of foreign bodies, fractures, etc., and forward to the wards at once. By this procedure we have been able to reduce the plating of cases by 40 to 50 per cent., and



furnish the surgeons with the diagnosis within a few minutes. The objections to screening and localizing at the same time are several. Firstly, there is the danger to the hands of the operator. It is doubtful whether after working several hours daily the gloves give ample protection, especially if the hands of the operator are already sensitised by previous burning.

Secondly, there are parts of the body, such as the neck, axilla, perineum, etc., where the curvature of the body prevents the ordinary fluorescent screen from being brought into close apposition with the skin surface. When the

depth of the foreign body beneath the screen surface is known, allowances have to be made for this separation, and whilst this is being carried out the patient is apt to move his position, and the work has to be gone over again.

Finally, the time spent in localizing, and the errors which often creep in owing to one not having the patient during the operation in exactly the same position as during the screen examination. As a result of various experiments I have been able to overcome all these objections.

The instruments I use are localizing pressure screens, 2, 4, and 6 inches in diameter. The smallest will fit into any part of the body, and the latter is large enough for any ordinary screen examination. The instrument in appearance looks very like a frying pan. Each has a long steel flat handle, from 6 to 8 inches in length, and the pan portion combines three purposes :—

(*a*) Fluorescent screen.

(*b*) Localizing apparatus.

(*c*) Cross wire marker.

(*a*) The bottom of the pan is made of aluminium, on which rests the fluorescent screen with its protection of glass or celluloid.

(*b*) Beneath the pan are two cross strips at right angles to each other. The one in line with the handle is of aluminium, the other being of thin steel. Beneath the handle is a thin, narrow aluminium movable rod, one end of which terminates half way up the handle in a pointer and finger button for movement of the rod. The other terminates in a small lead shot whose normal point is the centre of the cross wires.

As this rod moves up and down it records the depth of the foreign body in centimetres, which is scaled on the handle.

At present we have these instruments scaled for a distance of 52 cm., and a tube shift of 6 and 10 cm. We are always able, by the use of air cushions of varying thickness, to work at a distance of 52 cm. from the tube.

The method of procedure is as follows :—

First expose the part and search for the foreign body, and when it is found place the limb in the best position for operation purposes. Then cut down the beam of X-ray light until it just covers the screen. The lead shot which is at the normal zero position is made to just overlap some part of the foreign body, and the screen is gently pressed upon the part under examination. One of the diaphragms is moved so as to allow only a narrow slit of light to pass through, and then the tube is shifted to its second position. The shot is now made to follow the foreign body until it overlaps again, the traverse of which is indicated on the scale on the handle. On turning up the light, the depth is read off as so many centimetres or inches, and the impression of the rods is left on the skin of the patient in the form of a cross, which is at once made permanent by tracing it with moistened copying pencil or nitrate of silver. The round hole with raised edges in the far end of the handle is also used for localizing the direction of the pencil of light in the direct line of the foreign body. The handle is pushed beneath the patient, and when the hole is in

alignment with the foreign body it is gently pressed upon the skin, which, when examined, is found to show the shape of the circle.

Finally, this circle is made permanent by copying pencil.

In this way, if we think it best to plate the part, we have at hand the best data for doing so, and it is quite easy to overlap the cross wires with those of the plate holder.

These instruments were made by A. E. Dean, London.

A ROTATING PLATE CHANGING TABLE.

By A. St. George Caulfeild and R. Knox.

A simple method for the rapid changing of plates is often required. It being often necessary to take a number of plates in quick succession, the advantage of doing so will be readily appreciated by anyone who has to examine stomach conditions by means of the opaque meal. The ordinary methods employed do not allow of a sufficiently rapid change of plate to enable us to study the peristaltic wave of the stomach, particularly is it necessary to closely observe the behaviour of the pyloric end of the stomach and the duodenum. The screen examination is extremely useful, and gives the observer all the information he seeks, but when he attempts to obtain the same effects on a plate, or a series of plates, then he finds the need for a more accurate mechanical arrangement than most of the plate changers in use. Gregory Cole has solved the problem in radiography of the stomach in the prone position. Howard Pirie has recently described another form of table for the prone position. For the upright position we have not been so fortunate. Rosenthal and Rieder have used for several years a most complicated apparatus for the production of a pseudo-cinematographic effect by taking a number of plates, about six to a second. Dessauer has still more recently introduced a plate changer, designed to give a cinematographic effect, on much the same principle as Rieder and Rosenthal. In both the principle of the falling plate has been adopted. Both also suffer from the same disadvantages, extreme expense, coupled with a doubtful efficiency in practical work. Some time ago the subject was discussed by the writers, and as an outcome of the discussion Mr. Caulfeild designed and put together the apparatus described below. The apparatus combines extreme simplicity of design with a remarkable efficiency in execution, a combination somewhat infrequently met with in X-ray apparatus.

The following description explains the construction in such a way that any carpenter can readily construct the apparatus. In practice the apparatus will be found to be very useful. At the usual speed of operation six plates can be exposed in 12 seconds. The apparatus can be used for two or more plates, and the intervals between each exposure can be varied in several ways. The apparatus can be worked by hand instead of automatically, when the intervals

between the exposures may be as long as we desire, or by alternating the cassette or plates with dummies the intervals of time between exposures may be as follows :—

6 exposures in	2 seconds interval.	12 seconds in all.	
3 ,,	4 ,, ,,	12 ,, ,,	
2 ,,	6 ,, ,,	12 ,, ,,	

In stomach work these combinations will be found useful, as it is only necessary to examine the movements of the organ on the screen to determine what interval is necessary to get a complete cycle on the six plates. The plate changer can also be utilized for stereoscopic work, the plates automatically change position, while in the interval the tube may be displaced by hand or automatically, whichever is the more convenient method. The apparatus in its present form is only of value when very rapid exposures can be made. It works very well with a single flash apparatus or a transformer which is capable of giving good plates with exposures of about one twenty-fifth of a second. With exposures beyond this limit the pictures are apt to be blurred by the vibration of the plate, a condition which is unavoidable in this type of apparatus.

Details of Apparatus.

The scale of the original drawings is 3 inches = 1 foot, in the reduced reproductions the scale is about 1 inch = 1 foot.

A triangular frame A carries a bracket B, on one end of which is mounted the ball-bearing C, and at the other end a block carrying the sliding plunger D.

The circular table E rotates on the ball-bearing C, and is provided with a framework which holds the six cassettes F, which are arranged vertically round the edge of the table. A leaden weight H is placed in the centre of the table over the bearing. The table is rotated by a cord R (Fig. 2), and weight (not shown) ; the cord runs in groove R (Fig. 1). Beneath the table are six stops G, which butt the plunger D, and so check the movement of the table when any against plate is in position for exposure.

The plunger D is withdrawn by the pendulum K, one metre long, swinging from the bracket L. A short chain I (Fig. 1) connects the pendulum to the plunger. After withdrawal the plunger is returned by a spring (not shown). A lever J (Fig. 1) has a hook on its end, which holds back the pendulum when in position K1.

A spring M is attached to the pendulum rod, and a cigar-shaped piece N is fixed in such a position that the spring M, during the opposite swings of the pendulum, passes alternately above and below the piece N. At the end of N, and on its upper surface only, is a metal contact. N and M are electrically connected with the pilot lamp O, so that this lamp glows when the pendulum, moving from K1 to K, pulls M across the upper side of N. When the pendulum moves from K to K1, M passes on the under side of N and no contact is made.

A frame S carries a thin wood panel PWP, against which the patient leans. The lead lining PP has a window W exactly opposite the plate to be exposed.

A sheet of lead Q hangs down inside the revolving cassettes, but not touching them. Lead wings T are provided, as shown on the plan. The combination of the lead sheets, P, Q and T, stops any rays reaching any plate except that one which is facing the window at the time of exposure.

It was originally intended that the tube X (Fig. 2) should be fired by the contacts M, N, but it was found that these soon burnt up with the heavy currents necessary for quick exposures. The contacts are now connected to the pilot lamp O, which indicates to the assistant in charge, looking through the window of the protected cabin U, when to pull over the switch of the single

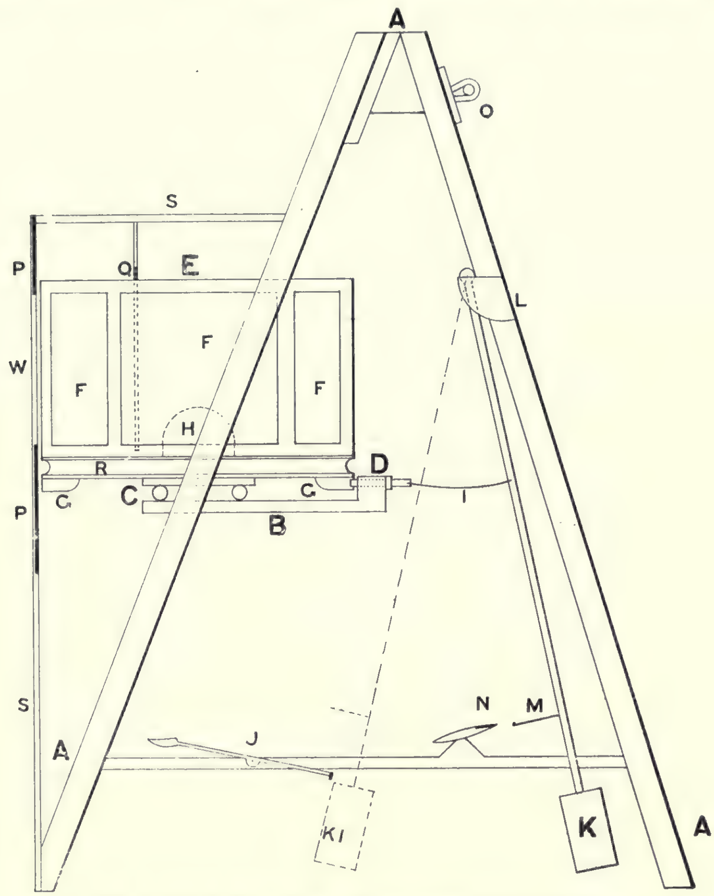


FIG 1.—Side Elevation. Scale about 1 inch = 1 foot.

flash apparatus. The pendulum completes its double swing in two seconds, which gives time for the assistant to manipulate the switch, and for the table to bring a fresh plate into position. The single flash assures the sharpness of the negatives. With relatively slow exposures of one-tenth of a second the effects of vibration were visible on the plate. This form of apparatus does not appear suitable for exposures at a quicker rate than one plate in two seconds. A new type of apparatus is now being considered, with which it is hoped to expose up to eight plates in one second. Any rate slower than one plate in two seconds can be got with the present form by working the plunger D by hand independently of the pendulum.

The apparatus is wound up by rotating the table by hand, thus lifting the weight. The pendulum is hooked back into position K1. The patient is adjusted against W. The foot lever J is depressed. The pendulum moves from K1 towards K. The spring M passes over N, and the contacts M N light the pilot lamp. The assistant in U pulls over the single flash lever V, exposing the first plate. The spring M leaves the contact N, the pilot lamp goes out. The further movement of the pendulum towards K tightens the chain I and withdraws the plunger D. The table begins to turn under the pull of cord R and weight. Pendulum now returns from K towards K1. The chain I slacks and a spring (not shown) pushes back the plunger D. The

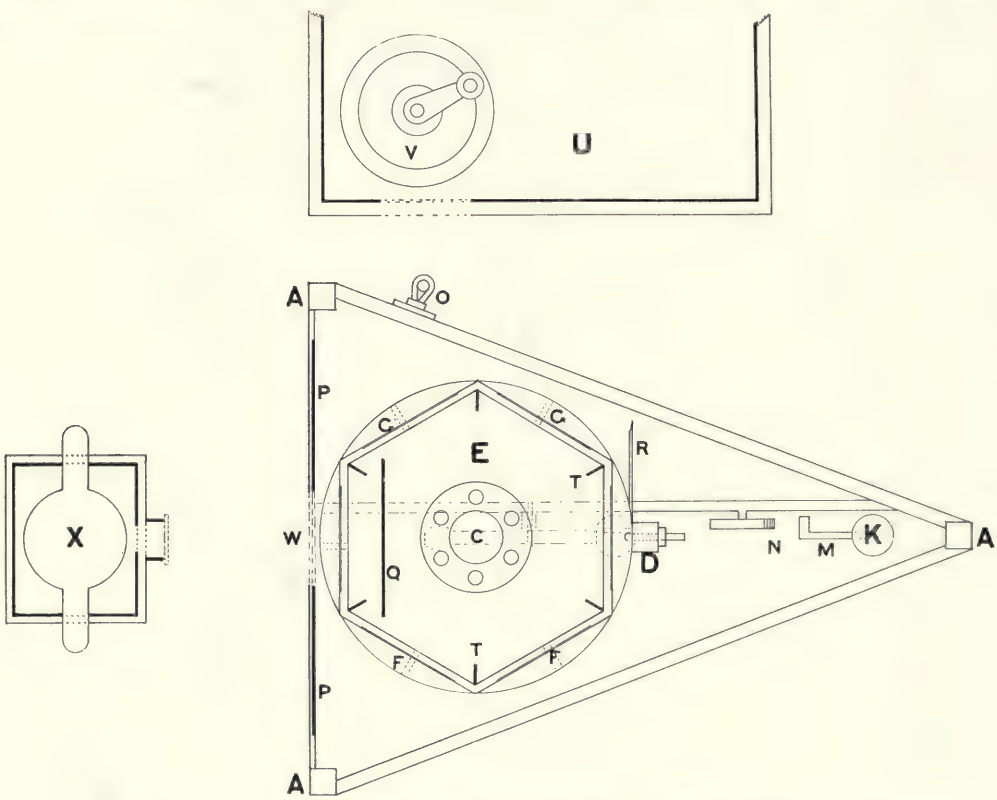


Fig. 2.—Plan. Scale about 1 inch = 1 foot.

revolution of the table brings one of the stops G against the plunger and the table stops with the next plate in position for exposure. The pendulum spring M now passes underneath the piece N. No contact is made. The pendulum is now at K1 position of its swing, and the cycle is repeated. The double swing of the pendulum takes two seconds. The contact N is set so as to light the pilot lamp about one-third of a second before the plunger is withdrawn. It is found that the single flash switch can be worked in this time. About one second elapses between withdrawing the plunger and the next stop coming against the returned plunger, so that about two-thirds of a second are available to partially damp out the vibrations caused by the sudden checking of the table. With single flash exposures no vibration is visible on the plate.

REPORT, WITH SKIAGRAM, OF A DISLOCATED LENS.

By J. D. Morgan, B.A. (Cantab.), M.D., C.M. (McGill), Capt. C.A.M.C.

Private J. H. was struck, on July 22nd, by some large object in the right temporal region. A radiogram was made of this region, on the 25th, and an abnormal shadow in the right orbit was noticed. The quality of the shadow was such as to indicate that it was not caused by a piece of metal, but rather by a body having considerable less density.

DISLOCATION OF LENS.

A careful examination was then made of the eye by Captain Calhoun, who reported as follows :—

"Circumorbital ecchymosis, more particularly marked at lower temporal region ; general ecchymosis of conjunctiva, pupil slightly dilated, regular, no iridodinesis, and no rupture of the tissues at any place ; was evidently hit by

large object from lower temporal direction. Light perception only present, except in lower temporal quadrant where he could distinguish objects. Ophthalmoscopic examination showed partial dislocation of the lens inwards and backwards, the lower portion still retaining approximately its proper place. The lens had become cataractous except at the temporal and upper margins which were still transparent. The rest of the fundus was normal."

It would seem, therefore, that the dislocated lens must be the cause of this abnormal shadow. Owing to the uncommon character of the skiagram it was thought to have sufficient scientific interest to make it worthy of being recorded.

A CASE OF FUNCTIONAL DYSPHAGIA.

By T. L. Bunting, M.D., F.R.S.E.

The accompanying radiogram illustrates a case of functional dysphagia, which I examined for Mr. A. E. Morison at the Northumberland War Hospital.

The patient, a soldier, age 36, was wounded in the right shoulder on July 31st. This appears to have been very slight, and he returned to duty. On August 28th, while going into action, he suddenly felt that he could not swallow, and his right arm and right side became numb. He went into hospital where an unsuccessful attempt was made to pass an œsophageal tube. A day or two later a tube was passed, after some difficulty, and the patient was fed by tube.

He was admitted to the Northumberland War Hospital on September 5th. He was then absolutely unable to swallow anything, and was fed by stomach tube, which passed easily. My examination was made on September 8th. The patient was given gruel, thickened with barium sulphate. By screen examination the gruel was seen to be arrested at the level of the cricoid, and was churned up intermittently by contractions of

the pharyngeal muscles. Mr. Morison pointed out that in this, as in other cases of functional dysphagia which he has treated, the stoppage occurred at the junction of two nerve supplies, the spinal and the glossopharyngeal. I am informed that the patient became able to swallow egg oysters on September 23rd, and that now (October 7th) he can eat chicken.

I am indebted to Colonel Adams, A.M.S., Commandant of the Hospital, for permission to publish these notes.

A CASE OF DIFFUSE FIBROMYOMA OF THE ŒSOPHAGUS, CAUSING DYSPHAGIA AND DEATH.

By Arthur J. Hall, M.D., Cantab., F.R.C.P., London.

Reprinted by permission from *Quarterly Journal of Medicine*, Vol. 9, No. 36, July, 1916. With Plates 24-32.

(*Continued from* p. 163.)

The Question of Compensatory Hypertrophy.

In trying to find an explanation of this case, the first point to settle is whether or not the hypertrophy has been secondary to obstruction.

Such compensatory hypertrophy, as we know from cases of cardiospasm or achalasia, does not necessarily connote an organic stricture; it may arise from a functional one. It is obvious that, whether organic or functional, a stricture of the œsophagus sufficient to cause such extreme hypertrophy must have indicated its presence by more or less dysphagia for some considerable time before its development. That in this case it did not do so, the evidence that we have is very clear.

The patient never suffered from dysphagia prior to January, 1913. Dr. Wright, of Dalkey, who was for many years a personal friend of the family and their medical attendant, assures me that he had never heard of anything of the kind previous to this date, and the history obtained from her friends fully confirms this. She had been subject to asthma, but she had never had any difficulty in swallowing. Yet, within two months of this first attack of dysphagia, a radiogram, taken by Dr. Watson, of Dublin (Plate 26), showed the presence of a shadow sufficient to warrant at that time a provisional diagnosis of intrathoracic growth.

Comparing this photograph (Plate 26) with those taken in December, 1914, by Dr. Knox (Plates 27, 28, and 29), and with the œsophagus found at autopsy a few weeks later (Plates 24 and 25), it is obvious from the general outline of the shadow that, *within two months of the onset of symptoms of dysphagia*, the œsophagus was almost, if not quite, as large as at the time of death. Unfortunately, the original photograph is not very clear for purposes of reproduction, but the following points can be distinguished in Plate 26:—

1. A shadow to the right of the vertebral column about the level of the fifth and sixth ribs. (This appears to be the shadow diagnosed as an intrathoracic tumour or mass of bronchial glands, and due to the upper swelling of the œsophagus.)

2. The right margin of a lower swelling just above the diaphragm on the right side.

3. An abnormal position of the apex of the heart, lifted up from the diaphragm and separated from it by the distance of an intercostal space. This feature is equally well shown in the later radiograms (Plates 27, 28, and 29).

4. A shadow due to the left margin of the lower swelling between the heart and the left side of the diaphragm (also seen in Plates 27, 28, and 29).

It is impossible to think that a hypertrophy of this extent, involving not only the lower but also the upper part of the tube, could have arisen as a compensatory mechanism after only two months' slight dysphagia. We must therefore conclude that the enlargement of the œsophagus already existed at the time of onset of her symptoms, and was not due to a pre-existing obstruction sufficient to produce symptoms.

That the hypertrophy is not primarily compensatory in character is confirmed by a study of the specimen itself. The only part of the

tube which shows sufficient narrowing to be called a stricture is in the upper swelling, whilst the bulk of the hypertrophy is below this, in the lower half of the tube. Below the upper swelling there is certainly no organic stricture.

On the other hand, the obstruction causing the lower swelling may have been functional, at the cardiac orifice, as in cardiospasm (achalasia). Against this view there is much to be said. In most cases of cardiospasm, dilatation is marked, or even extreme, and the ratio of dilatation to hypertrophy is greatly in favour of the former. Several cases have been recorded in recent years. In some it is difficult to estimate the exact ratio of dilatations to hypertrophy owing to the absence of any measurements and the use of indefinite terms, such as "great" or "excessive," in describing the size of the lumen or the thickness of its walls. Occasionally, however, an illustration in the text, or a statement as to the thickness of the walls, gives definite information on this point.

Thus, Sippy (1), describing a specimen removed from a woman, aged 40, who died with a dilated œsophagus after about five years' dysphagia, states that "at the point of greatest dilatation the circular fibres alone were 0·5 cm., the longitudinal fibres 0·2 cm. in thickness. From here upward the hypertrophy gradually diminishes." This was a case of idiopathic dilatation due to cardiospasm.

Kinnicut (2), in a case in which dysphagia had existed for twenty years, off and on, states that the greatest thickness of the muscular coats was 0·5 cm. Zenker and v. Ziemssen (3) speak of a thickness of 0·5 cm. as "great hypertrophy."

Much the same holds good for such specimens as I have been able to see or hear of in the pathological museums of this country. In the museum of St. George's Hospital there are two specimens of simple muscular hypertrophy of the œsophagus without discoverable cause. I have had an opportunity of seeing these, and the walls at their thickest point do not exceed about 0·5 cm. across. From the P. M. records of the London Hospital Dr. H. M. Turnbull kindly informs me of two records of "idiopathic hypertrophy" of the œsophagus. Each is described as "great hypertrophy." Whether these specimens are preserved in the museum or not I cannot say, and there is no statement in the record sent me as to any actual measurement of the walls.

Apart from these, in answer to inquiries, I have not obtained any report of existing specimens of œsophageal hypertrophy. It seems fair to assume that a purely compensatory hypertrophy of the œsophagus, however great the dilatation, rarely exceeds 0·5 cm. in thickness, or thereabouts.

A hypertrophy such as this specimen shows, in which the muscular walls measure more in diameter than the lumen of the tube at its greatest dilatation, is contrary to all experience in cases of cardiospasm.

Again, in this specimen the hypertrophy does not cease at or above the cardia. Seen from without (Plate 24), it is impossible to say exactly where the cardia is situated, for it lies concealed in the lower part of the larger swelling. Seen from within (Plate 25), the orifice is quite distinct, measuring 2 cm. across, and the hypertrophied mass continues for 3 or 4 cm. into the stomach walls below. Lastly, in this specimen the sites of the narrowest parts of the lumen are also the sites of greatest overgrowth of walls, and the narrowing is really a flattening in one plane due to the pressure inwards of the thickened walls.

The points against this being a compensatory hypertrophy may be summed up as follows:

1. Within two months of the onset of dysphagic symptoms a radiogram shows intrathoracic shadows corresponding in size and position with those taken a few weeks before death.

2. The bulk of the overgrowth is below the only part of the lumen which may be termed a stricture.

3. The lower extent of the growth does not cease at the cardia, but continues for 3 or 4 cm. into the anterior and posterior stomach walls.

4. The ratio of dilatation to hypertrophy usually found in cases of cardiospasm is in this case reversed.

5. The narrowest parts of the lumen correspond with the thickest parts of the walls; if it is compensatory it has defeated its object by causing, instead of relieving obstruction.

It may seem unnecessary to emphasize this point seeing that a comparison of this speci-

men with those of compensatory hypertrophy shows the differences quite clearly. It must be remembered, however, that dilatation with secondary hypertrophy is the common condition, and the one which in this case was naturally suspected during life in spite of many anomalous features.

As the theory of compensatory hypertrophy is obviously impossible it is necessary to consider some alternative. Of these there seem to be only two. It might be (1) a congenital hypertrophy of the muscular coats, a maldevelopment, or (2) a diffuse neoplastic growth of later origin.

1. *Congenital Hypertrophy.*

Various forms of congenital mal-development of the œsophagus are referred to in all text-books of pathology. With most of the varieties this case has nothing to do, and they need not be considered here. The only forms that concern us in connection with this case are the alleged cases of congenital stenosis and congenital dilatation.

It does not seem necessary to consider the former at length; a congenital stenosis which produces no dysphagia for sixteen years is hardly a stenosis at all. As regards the cases of congenital dilatation, however, there seemed at first sight a hope of enlightenment, for in most of the text-books there is added the words—"a kind of forestomach! (*Vormagen*)." The constancy with which this formula is exactly repeated in successive text-books is a little suspicious! The evidence upon which it is based seems to be a single specimen described by v. Luschka (4) in 1868. It was found in a woman, aged 50, who since girlhood had been able to return her food at will.

Measurements are given which enable us to compare the relative amount of dilatation to hypertrophy. Thus the circumference of the tube at its widest part was 30 cm., whilst the greatest thickness of the hypertrophied wall was 0·45 cm. The diameter of the lumen at its widest part must therefore have been between 8 and 9 cm. with a maximum wall thickness of under 0·5 cm. That is a ratio of dilatation to hypertrophy of about 17 to 1. (In my case the ratio is nearly 1 to 1·5.) The plate which accompanies the account of v. Luschka's case shows two swellings in the œsophagus, an upper smaller and a lower much larger; so that from the external surface its appearance is at first sight not dissimilar to that seen in my case (Plate 24). But there is one important difference. In v. Luschka's specimen the lower swelling narrows down at the point of entry into the stomach to an apparently normal width, whilst in my specimen (Plate 24) the swelling extends into the upper part of the stomach and the circumference at this point is as great as in the widest part of the upper swelling. I have mentioned the account of this specimen in some detail because, as I said before, it is referred to in most of the text-books as the example of congenital dilatation of the œsophagus (a forestomach), and because it gives details of measurements. v. Luschka himself remarks upon the uncertainty of its origin, and says that the evidence of its being congenital is merely based upon the duration of symptoms since youth. In the light of recent X-ray work in connection with dysphagic cases, it seems quite likely that this was primarily a case of achalasia with secondary dilatation and compensatory hypertrophy. The existence of congenital dilatation becomes, therefore, very doubtful.

Having thus failed to find any record of a purely hypertrophic mal-development of this region, one naturally turns to other parts of the alimentary canal to see if anything comparable occurs in them.

The best known example of such localized and limited hypertrophic mal-development is that first described by Hirschsprung (5), now generally known as megacolon congenitum, or Hirschsprung's disease. The three cases described by him occurred in infants, two of them living only a few months, the third only a few hours. Hirschsprung's original suggestion that the condition was really congenital was based upon the two former cases and was confirmed later by the third.

In these specimens, of which measurements are given in full, it is obvious that, allowing for the size of the infantile organs as compared with those of an adult, the actual hypertrophy of the walls of the colon is very great; thus in one specimen it reached 0.3 cm. in thickness. In one respect, however, these specimens of intestine described

by Hirschsprung differ from this specimen of œsophagus: in the former all the coats were thickened—mucous as well as muscular; in the latter the hypertrophy is entirely limited to the tunica muscularis; the mucosa shows no enlargement. It is interesting to note that in his third case the change reached up a short way into the ileum just above the ileocolic valve, just as in my specimen it extends beyond the cardia into the stomach.

At the time of Hirschsprung's paper no similar case had been described, and his apology for presenting something hitherto unknown is so apt to the present circumstances that I give a translation of it, although it does but scant justice to the original:

"(5) The question then arises whether such a luxuriant overgrowth could be confined to so comparatively short a length of intestine, actually forming so limited a portion of the body. *A priori* one would be inclined to look upon such a limitation as in a high degree improbable, and this is confirmed by our finding in the literature isolated accounts of analogous congenital abnormalities elsewhere in the digestive canal. I refer you to the congenital dilatation of the stomach which Rokitansky described (*Lehrbuch der path. Anat.*, 1861, Bd. iii, S 148) and to the primary total dilatation of the œsophagus which, according to Eichhorst (*Handbuch*, 1885, Bd. ii, S. 48*), is frequently found of congenital origin. Whether, however, the dilatation in these cases was associated with hypertrophy of the wall in some or all its layers, I have no evidence to show; I must therefore not assert that the analogy with the findings in the lower parts of the alimentary canal is complete in this respect. If we seek for allied conditions in other viscera of the body, the literary harvest appears a rich one, and there are not many inner parts which have not been found at birth to be overdeveloped. In Förster (6) one finds the richest contributions to our knowledge on this subject. He says: 'Congenital hypertrophy is found in all the inner parts—in the brain, the spinal cord . . . further as malformations in the larynx, tongue, liver, spleen, thyroid, suprarenals, kidneys, testes, ovaries, mammæ, uterus, and heart.' The intestine is not named in this collection, but it is difficult to see why the intestinal canal should not be subject to the same morbid processes as the majority of the other internal organs. Here is an empty space which my cases can bravely fill."

* This reference is to v. Luschka's case mentioned previously.

It is somewhat tempting to apply the same form of argument to the present case, and to say that although congenital hypertrophies of the œsophagus have not been previously recorded there is no inherent improbability in their occurrence, and that here is an example to prove it.

There are two obvious difficulties in such a view. In the cases of megacolon symptoms of impaired function showed themselves soon after birth; in my case no symptoms whatever occurred until 16 years of age. Such a difference might conceivably be owing to the different functions of the two parts of the alimentary canal, but it is a real difficulty. The other point is the limitation of overgrowth in this case to one layer of the tube—the tunica muscularis, and the complete absence of hypertrophic change in the rest.

I am not aware whether in any recorded case of megacolon congenitum the hypertrophy has been thus limited to one coat. In Hirschsprung's original cases it was not so.

2. *Diffuse Neoplastic Growth.*

Microscopically the specimen consists of unstriped muscular cells, together with a certain amount of fibrous tissue, and belongs to the group of leiomyomata. As is well known, leiomyomata are not very rarely found in the muscular coats of the alimentary canal, including the œsophagus. They may be single or multiple. As a rule their discovery is an accidental one at autopsy and no symptoms have been recorded during life. Sometimes, either on account of their size or of their pedunculated nature, they have produced mechanical obstruction and dysphagia.

Inquiries made from the curators of the leading pathological museums in the United Kingdom show that such specimens exist in several. Most of them are only of small size

(1 or 2 cm. long). At University College Hospital there is a larger one, No. 1527 B. It is described as "ovoid, 3 inches long, lying in dilated tube causing erosion and laying bare some of tracheal rings. No history." Hilton Fagge (7) recorded a specimen of this kind: "Egg-shaped, 2 in. long $\times$ 1 $\times$ 1¼. It was below the bifurcation of the trachea, underneath the mucosa, which was movable over it. There was no dysphagia."

Coats (8) reports a pedunculated leiomyoma which caused death by obstruction. It measured 4¾ in. long by 2 in. in circumference and was attached by a narrow stalk. The lower end reached to the cardia.

Eberth (9) described a specimen in a female, 50 years of age, in whom there were no symptoms during life. It was situated just above the cardia: arose in the circular muscular fibres involving the posterior wall only, and measured 9·1 cm. long $\times$ 3·5 cm. thick $\times$ 11·9 cm. broad.

These isolated examples of myoma of the œsophagus, of somewhat large dimensions, are the exceptions which prove the rule laid down in most works on pathology, that leiomyomata of the œsophagus are seldom larger than a bean.

A diffuse myomatous growth in the œsophagus extending into the walls of the stomach is not described in any work to which I have had access. And yet the conditions in this specimen—the massive lobulated overgrowth of unstriped muscular tissue spreading irregularly along almost the whole length of the tube; the division into two masses; the actual displacement upwards of the heart; the occlusion of the canal by inward growth of muscular tissue; the extension of growth below the limit of the cardiac orifice—all these suggest spontaneous overgrowth such as occurs in myoma.

If we turn to the chief seat of myomatous tumours, namely, the uterus, the literature on the subject is very abundant.

Myomata in this organ are, as a rule, circumscribed, but cases occur occasionally of so-called "diffuse fibromyoma" in which the growth has no definite boundaries, but is diffused throughout the whole organ. That being so, there is no *prima facie* reason why a similar diffuse myomatous growth should not take place in a portion of that system, viz., the alimentary canal, which, after the uterus, is the commonest site of myoma.

A common feature of uterine myomata is multiplicity, and this tendency is also not uncommon in cases occurring in the alimentary canal. In the present case there is a suggestion of such a tendency in the presence of two swellings or centres of chief growth in the diffused mass (Plates 24 and 25).

Again, uterine myomata may be polypoid or they may not. This difference probably depends upon simple factors of position and physical conditions of accidental origin. As a rule the circumscribed leiomyomata of the œsophagus are polypoid. The absence of any polypoid development in this case may be explained by its diffuse circular development—there is no normal thin wall from which it can drag downwards and become polypoid.

Conclusions.

The conclusions upon which the diagnosis of diffuse fibromyomatous growth of the œsophagus are based are:

1. The general naked-eye appearance, which resembles that of a uterine fibromyoma.
2. The histological structure.
3. The limitation of growth to the muscular coat.
4. The sharply defined upper and lower margins—the latter not limited by the cardiac orifice, but extending some way into the stomach.
5. The replacement of the normal striped muscle in the upper œsophagus by unstriped muscular tissue.
6. The actual compression of the lumen by encroachment of the growth.
7. The occurrence of analogous cases of diffuse myomatous growth in the uterus.

There seems little or no evidence to show at what period of life the ordinary leiomyomata of the œsophagus arise, and it seems impossible to form an opinion as to when the growth in my case began. We know that within a few weeks of the onset of symptoms it was very extensive. Its possible congenital origin has been considered previously, and the verdict is "not proven."

The question naturally arises as to whether

the onset of symptoms in this case may have coincided with a more rapid development of a previously existing growth. Such rapid development might be occasioned by what was innocent becoming for some reason malignant. It is well known that this does happen in uterine myomata and that sarcomatous changes in them are not uncommon. The frequency of this occurrence is somewhat variously estimated by different observers, but may be taken roughly at about four per cent. of cases coming to operation.

Griffith and Williamson (10), in recording such a case, formulate four different conditions under which it may occur:

1. There may be present in the same uterus two entirely separate and distinct tumours, the one a sarcoma, the other a fibromyoma.

2. A sarcoma may originate in some more or less distant part of the uterine wall and subsequently invade a fibromyoma.

3. A sarcoma may arise *de novo* in a pre-existing fibromyoma : a new growth within a new growth.

4. Possibly the cells of which the existing fibromyoma is constituted may assume malignant characters.

There is nothing in this specimen which could be included under the headings (1) or (2). It is also clear from the microscopic examination of sections taken from most parts of the growth that the cells do not show any malignant characters histologically, and that to most of the growth the condition described under (4) could not apply. But with regard to the third heading, sarcoma developing in some part of a pre-existing fibromyoma, there are certain features in this specimen which are at first sight a little suggestive.

In the upper part of the upper swelling (Plate 25) there is a limited area in which there are a few small hæmorrhagic foci. Can this be a seat of sarcomatous change? In uterine myomata becoming sarcomatous the area of such change may be very limited, and hæmorrhages into the substance are not uncommon.

Judging by the literature, sarcoma of the œsophagus is amongst the rarest of diseases. v. Hacker (11), in 1909, was able to collect 21 cases of sarcoma of the œsophagus recorded up to that date, together with four cases occurring in the hypopharynx. From a review of these, it appears that, like carcinoma, it occurs more commonly in the later decades of life, 40-70, differing in this respect from sarcoma in general. Three-fourths of the cases occurred in males. The most common site of origin was in the thoracic œsophagus, usually in the lower part. In contrast to carcinoma there is no special predilection for the narrower parts of the tube. It may occur as either (1) a circumscribed growth, or (2) as a diffuse infiltration of the walls, or (3) both forms may be combined. As a rule the circumscribed variety projects into the lumen of the tube, forming a polypoid swelling.

The infiltrating form may lead to thickening of the walls or to the formation of knobby palisade-like projections of the surface. From this thickened wall polypoid or cauliflower-like growths may push into the lumen. In some cases ulceration occurs, in others the mucous surface remains unbroken, as in Ogle's case (12).

The growth may involve the circumference of the walls completely, as in cases recorded by Rolleston (13), Shaw (14), and Starck (15), or it may nearly do so. As a rule a part of the circumference is free. In a considerable number of cases the anterior wall has been chiefly involved. Some are described as firm, hard tumours, others as soft or even of pulpy consistence. The latter tend as elsewhere to destruction of tissue and to extension by metastasis. As regards the histological structure, many of the cases are somewhat incompletely described, and it is difficult to form an opinion as to their exact nature.

Amongst the varieties described are lymphosarcoma (16) (one case), and melanosarcoma (17) (one case). The others include round-celled, spindle-celled, and mixed round-and spindle-celled.

It is obvious that in the specimen here recorded there is very little which fits in with the cases of sarcoma hitherto reported. Most of them occurred in much older persons, usually between fifty and seventy. Most of them are described as arising in the submucosa: metastases occurred in several. Ulceration of the mucosa, or softening of the growth, or polypoid projection into the lumen was common.

On the other hand, some of the infiltrating circular sarcomata, described as of firm consistence with little tendency to metastasis and involving considerable lengths of the tube, approach in general conditions more nearly to my specimen than anything else I have found in the literature.

As regards histological structure the cases of typical round-celled sarcoma, or myeloid, or lymphosarcoma do not enter into the question, but the exact nature of those described as leiomyosarcoma and rhabdomyosarcoma seem to be somewhat uncertain, and although their similarity to my case is not a close one, yet they resemble it to some extent. Two of these cases are described as rhabdomyosarcoma, the tumours containing and arising in striped muscle.

Wolfensberger's (18) case shows from the photographic reproduction a diffuse warty nodular surface of the œsophageal lumen, not altogether unlike the inner surface of the lower swelling in this case (Plate 25). A sectional view, however (loc. cit., Fig. 21, p. 508), shows that there is really no comparison between the two.

Glinski's (19) case was a polypoid growth at the lower end of the œsophagus, consisting chiefly of spindle cells with connective tissue and bundles of striped muscle fibres. The presence of striped muscular tissue so low down in the œsophagus is somewhat unexpected, and suggests an original developmental anomaly with secondary sarcomatous changes. Neither of these specimens contained any unstriped muscle cells.

There only remain two other cases in v. Hacker's list. These seem to be somewhat allied to the condition found in my specimen. One of them, recorded by Howard (20), is described by him as a "primary myosarcoma of the œsophagus with metastases in the stomach and neighbouring lymphatic glands." The primary growth began 12 cm. above the cardia, but the actual form, extent, and situation as regards the tube, it is impossible to picture from the description he gives. The growth seems to have arisen in the muscular coat, and although the mucosa was ulcerated it appears not to have been invaded by growth. The bulk of the growth consisted of large fusiform sarcomatous cells and non-striped muscle cells. Howard is satisfied that he could distinguish gradations from the latter to the former.

The secondary metastatic growth in the stomach measured 7 cm. across, and had a similar structure.

Eppinger's specimen (21), which formed a polypoid tumour projecting into the lower part of the œsophagus, measured about 10 cm. in length. It was found at autopsy in a man of seventy. In structure it showed large spindle cells together with normal unstriped muscle cells. It is described as a leiomyosarcoma. It seems possible that these two specimens are both examples of sarcomatous changes in leiomyomata of the œsophagus.

The final appeal in deciding whether my specimen is undergoing sarcomatous change or not must necessarily rest with the interpretation of the histological appearances found in the suspected area. Judged by the ordinary standards the answer seems to be in the negative, but, as one knows in cases of myomatous growth, the line of demarcation between an unstriped muscle cell and a spindle cell of sarcoma is often difficult to draw. There are, however, other facts which, although merely negative, yet make sarcoma unlikely.

First, there is complete absence of metastasis. Secondly, if we assume sarcomatous change as the cause of increased activity which determined the onset of symptoms, the sarcomatous focus should have advanced much further than it did during the remaining two years of life.

It seems, therefore, that this specimen is best described as a diffuse fibromyoma of the œsophagus—leaving the question of whether it was a congenital mal-development or a growth arising later in life at present unanswered.

Before concluding it may be of interest to note the relationship of the symptoms during life to the findings at autopsy. It is evident that during the early development of the growth the patient had no difficulty in swallowing. This is remarkable, for, although it is probable that the growth had not at that time compressed the lumen to the extent it did later, yet it is surprising that with such an overgrowth of muscular tissue some incoordination of action should not have occurred.

If one considers also the various directions of the muscular fibres and the relative smallness of the longitudinal coat, this absence of early dysphagia becomes even more surprising. Whether the symptoms at their first onset were due to actual narrowing of the lumen or to muscular incoordination it is impossible to say, but the fact that they disappeared for over a year makes the latter more probable. This temporary disappearance of symptoms is characteristic of the common form of muscular incoordination of the œsophagus which Hertz (22) describes as achalasia. Probably towards the end the chief obstruction was mechanical, due to the compression of the lumen by the upper swelling.

In conclusion I desire to express my sincere thanks to many colleagues who have furnished information about this case or about specimens of œsophageal growths in their possession. I must especially thank Miss Eaves, of Sheffield University, for preparing microscopical sections, Professor Douglas for his valuable help as to the histology, and Drs. Knox and Watson for permission to reproduce their excellent radiograms. Fig. 3, Plate 31, is reproduced by kind permission of Messrs. Longmans, Green & Co.

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19. Glinski, *Virchow's Arch. f. Path., Anat. u. Physiol.*, Berlin, 1902, clxvii. 383.

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21. Eppinger—recorded in full in v. Hacker's paper, *loc. sit. supra.*

22. Hertz, *Quart. Journ. Med.*, Oxford, 1914-15, viii. 300.

DESCRIPTION OF FIGURES.

PLATE 24. Œsophagus, anterior surface.

PLATE 25. Œsophagus, laid open to show lumen.

PLATE 26. Radiogram of thorax, taken March, 1913, by Dr. E. Watson, Dublin.

PLATES 27, 28, 29, 30. Radiograms of thorax, before and after bismuth meal, taken December, 1914, by Dr. Knox, London.

PLATE 31, FIG. 1. Section through upper œsophagus. (× 10.)

FIG. 2. Ditto. Microphotograph. (× 8.)

FIG. 3. Section of normal œsophagus.

PLATE 32, FIG. 1. Section through cardiac stomach, in region of fibromyomatous growth. Microphotograph. (× 8 diam.)

FIG 2. Ditto, just below region of growth. Microphotograph. (× 8 diam.)

REPORT OF SOCIETY.

ADVISORY COMMITTEE OF CIVILIAN PHYSICIANS AND SURGEONS ON MEDICAL PREPAREDNESS

INFORMALLY, it was brought to the attention of a number of civilian physicians that a consulting committee on medical preparedness would be desirable. This resulted in a suggestion that the presidents of the American Medical Association, the American Surgical Association, the Congress of American Physicians and Surgeons, the Clinical Congress of Surgeons of North America, and the American College of Surgeons should jointly appoint an ad interim committee which could co-operate in developing the civilian and reserve medical resources of the country to the highest point of efficiency. As a result of these suggestions, the following committee was appointed in the manner indicated, the presidents of the various societies acting as members of the committee:

William J. Mayo, Chairman, Rochester, Minn.
Frank F. Simpson, Secretary, Pittsburgh, Pa.
Frank Billings, Chicago.
John F. Binnie, Kansas City, Mo.
Joseph C. Bloodgood, Baltimore.
George E. Brewer, New York City.
George W. Crile, Cleveland.
J. M. T. Finney, Baltimore.
Charles L. Gibson, New York City.
Robert G. LeConte, Philadelphia.
Fred B. Lund, Boston.
Edward Martin, Philadelphia.
Franklin H. Martin, Chicago.
Rudolph Matas, New Orleans.
Charles H. Mayo, Rochester, Minn.
Lewis S. McMurtry, Louisville, Ky.
John B. Murphy, Chicago.
Albert J. Ochsner, Chicago.
Charles A. Porter, Boston.
Charles A. L. Reed, Cincinnati.
Emmet Rixford, San Francisco.
Hubert A. Royster, Raleigh, N. C.
George E. de Schweinitz, Philadelphia.
Henry Sewall, Denver.
Richard P. Strong, Cambridge, Mass.
William S. Thayer, Baltimore.
Albert Vander Veer, Albany, N. Y.
Victor C. Vaughan, Ann Arbor, Mich.

This Committee met in Chicago for organization on April 14. Dr. William J. Mayo of Rochester, Minn., was elected Chairman of the Committee. Dr. Frank F. Simpson of Pittsburgh, Secretary, and an Executive Committee chosen as follows:

George E. Brewer.	William J. Mayo.
George W. Crile.	Franklin H. Martin.
J. M. T. Finney.	Frank F. Simpson.
Robert G. LeConte.	William S. Thayer.
Fred B. Lund.	Albert Vander Veer.

On April 20 the Executive Committee met in Washington and presented in person to President Wilson the following memorandum:

WASHINGTON, D. C., April 26, 1916.

Dear Mr. President:—We, the undersigned, acting as a committee on behalf of four national societies, to wit: the American Medical Association, the Congress of American Physicians and Surgeons, the Clinical Congress of Surgeons of North America, and the American College of Surgeons, representing an aggregate membership of 90,000 medical men, have the honour respectfully to present our greeting and to tender to the Federal Government our services toward the medical welfare of the Army and Navy, being impelled so to do by the following considerations:

1. In times of peace as well as in times of war, the medical profession, as above represented, holds itself in readiness, out of a spirit of patriotism and of co-operation, to serve the best interests of the Federal Government.

2. The European war, especially during its first six months, demonstrated a greater need, both of medical supplies and of more efficient organization of medical resources, in connection with military and naval activities than was formerly deemed necessary or adequate.

3. Every soldier and sailor in the service of the Federal Government is entitled at all times to protection in sanitary matters, and to proficient medical and surgical care.

Prompted, therefore, by these considerations, the medical profession, as above represented, respectfully offers its services toward

the well-being of the army and navy departments. Among the services which at this time the above-named organizations specifically tender their co-operation, in conjunction with existing facilities of the Army and Navy for such purposes, are:

1. To establish, through their respective membership and their affiliations with local medical societies of the states and territories, an organization that would be in a position to make a comprehensive survey of the medical resources of the country.

2. To make a complete invoice of such resources available in peace and in the emergency of war. This invoice would include not only the names of men available for field or home duty who are trained in the specialities of medicine, surgery, and sanitation, but it would also include the extensive equipment under the control of these men, such as hospital facilities and lists of trained nurses.

3. To aid in the public health service, in sanitation, quarantine, and hygiene of the troops; to aid in the inspection of camps and posts; to analyze water sources and supply systems; to study effects of climates, exposure, diet, etc., all designed for the welfare of the individuals enlisted in the Army and Navy Departments.

The medical profession, as above represented, respectfully submits that thorough organization of the civilian and reserve medical resources of the country are of primary importance in the proper preparedness of the country. It does not, however, here and now offer or imply any recommendation as to the national policy for preparedness beyond adequate sanitary, medical, and surgical protection of those who may be enlisted in the army and navy departments.

Respectfully submitted,

William J. Mayo,
Chairman, Committee of American Physicians.

Albert Vander Veer,
President, American Medical Association.

William S. Thayer,
President, Congress of American Physicians and Surgeons.

Fred B. Lund,
President, Clinical Congress of Surgeons of North America.

J. M. T. Finney,
President, American College of Surgeons.

Frank F. Simpson,
Secretary, Committee of American Physicians.

George E. Brewer.	Lewis S. McMurtry.
George W. Crile.	John B. Murphy.
Franklin H. Martin.	Albert J. Ochsner.
Frank Billings.	Charles A. Porter.
John F. Binnie.	Charles A. L. Reed.
Joseph C. Bloodgood.	Emmet Rixford.
Charles L. Gibson.	Hubert A. Royster.
Robert G. LeConte.	Henry Sewall.
Edward Martin.	Richard P. Strong.
Rudolph Matas.	Victor C. Vaughan.
Charles H. Mayo.	G. E. de Schweinitz.

The General Committee, in pursuance of its plan for a general survey of the medical resources of the country, has selected a committee in each state to aid in the work. These state committees are listed below. Members of the General Committee are also members of the state committees for the states in which they reside. To the General Committee have been added the following as members ex officio:

Honorary Members.

W. C. Gorgas, Surgeon-General, United States Army.

W. C. Braisted, Surgeon-General, United States Navy.

Rupert Blue, Surgeon-General, United States Public Health Service.

Colonel Jefferson R. Kean.

Major Robert E. Noble.

President, American Medical Association.

President, American Surgical Association.

President, Congress of American Physicians and Surgeons.

President, Clinical Congress of Surgeons of North America.

President, American College of Surgeons, with the following as Associate Members:

J. F. Anderson, President American Public Health Association.

Winford Smith, M.D., Baltimore.

Eugene Smith, Dean, Harvard Dental School.

Edward C. Kirk, Dean, University of Pennsylvania, Dental Department.

Thomas L. Gilmer, Dean, North-western University, Dental Department.

REVIEW.

Fractures and Dislocations, Diagnosis and Treatment. By MILLER E. PRESTON, A.B., M.D., Surgical Examiner, Colorado State Board of Medical Examiners. With chapter on *Roentgenology.* By H. G. STOVER, M.D., Professor of Roentgenology, School of Medicine, University of Colorado.

Dr. Stover has written a chapter on Roentgenology in this book. He appears to be also responsible for the majority of the radiograms which are used to illustrate the text. The reproductions of these latter are curiously uneven in quality. Some are excellent, but the majority do not reach the same high standard. Some, on the other hand, are such that even when the site of fracture is indicated by an arrow the solution of continuity is extremely difficult to make out. Their value would have been enhanced if more had been outlined as is Fig. 62 on page 50. A few prints from positives are included. We look in vain for radiograms to illustrate fractures of phalanges, and upper jaw injuries.

The X-ray photographs found in the chapter on "Fractures of Skull" number one only, and this is a skiagram of a skull showing bullet and site of entry. We had hoped to find more, for fractures of the skull at the present time are common and of great importance. No radiogram is produced to show dislocation of hip.

The advisability of including in a treatise on "Fractures and Dislocations" a short chapter on "X-ray Apparatus and Technique" is open to doubt. Of necessity, the subject under such conditions can be dealt with only in the most cursory manner.

The author details some of the advantages in having a radiogram of every case of suspected fracture, and then describes very briefly a portable outfit. His advice as to what should be inscribed on the envelope in which the plate is to be stored is sound, but hardly necessary. His opinion as to the introduction of "plates" in evidence is interesting in relation to American Courts of Law. The statement regarding the law of "inverse squares" is hardly accurate, for the author does not take into account the fact that the source of rays from any Crooke's tube is not a point. He further omits to take into consideration secondary rays from the glass itself.

Some form of technique is then rapidly and equally briefly described, and further on he enumerates methods of protection. However, all mention of secondary radiation from gloves, etc., is omitted.

After a few words devoted to the development of X-ray plates a series of short paragraphs dealing with those things the budding radiologist should and should not do brings this chapter to an end. We cannot say we are disappointed with the effort to condense the science of radiology, even for beginners, into one short chapter, for such an effort is doomed to failure before it is begun. We do think, however, that the radiograms used as illustrations are hardly worthy of the treatise.

NOTES AND ABSTRACTS.

RADIOGRAPHY.

Fluoroscopic Bronchoscopy.—G. W. GRIER (*American Journal of Roentgenology,* March, 1916, p. 123).—The writer thinks that fluoroscopy is only indicated when the foreign body is located in a bronchus or other structure which is inaccessible to the bronchoscope. In these cases a forceps can be projected beyond the end of the bronchoscope and the foreign body grasped and removed with the aid of fluoroscopy, which should be carried on in two planes at right angles to each other. No attempt should be made to remove the foreign body by the aid of the fluoroscope alone without the use of the bronchoscope.

A special device is described and illustrated for screening in these two planes, without

turning the patient, by means of two properly protected tube boxes. One is below the table and the other at the side and just above the level of the table. Both of them move together in the long direction of the table, while the underneath one also moves crossways, and the side one in an up and down direction.

In operation the current is shifted from one tube to the other by means of a string attached to a high tension switch, and held in the hand, while a double foot switch varies the strength of the current.

The Roentgenologic Diagnosis of Duodenal Ulcer.—By R. D. Carman (*American Journal of Roentgenology*, May, 1916, p. 252).—Carman frankly admits that he was formerly one of those who questioned the value of deformity of the duodenal bulb. He now, however, considers this sign to be one of our best indices capable of practical application, and well worth searching for in those cases in which the more simple methods of examination fail to establish or exclude the presence of duodenal ulcer.

The definite bulbar deformities more or less characteristic of duodenal ulcer are of various types, among which the following are noteworthy:—

1. General distortion, with sharply outlined projections and incisura-like indentations, giving the cap the semblance of a miniature pine-tree or a bit of branched coral. This sort of bulb almost always means duodenal ulcer. The distortion is largely organic; if partly due to spasm the latter element is persistent and unvarying. In many cases of this type the whole contour of the bulb is deformed; in others only one border or the basal portion is distinctly irregular. That a pericholecystitis or adhesions from other inflammatory processes in this vicinity may produce a similar deformity must be admitted, and should be kept in mind as a possibility. Cancer of the duodenum is so rare that it should be thought of last of all.

2. The niche type. The excavation of the ulcer is visible as a barium-filled recess in the bulbar chamber. It varies from a wheat grain to a pea, or larger, in size, and its barium content is often denser than that in the rest of the bulb. The niche may or may not be accompanied by spastic incisuræ.

3. The incisura type of deformity. The incisura may be single or bilateral. It is usually small but sharply outlined, is evidently spastic and presumably occurs in the plane of the ulcer. As a rule it is significant of ulcer, but we have had one case in which delicate adhesions confined to the anterior duodenal wall were the cause.

4. A fourth variety is a bulb represented by a very small but compact mass of barium. There is no particular irregularity of contour, but the bulbar shadow is abnormally small. Occasionally it is produced by a contracting stenosing ulcer. The duodenum of a steerhorn stomach, which often turns rather abruptly backward, may also give this sort of shadow in the antero-posterior view.

The writer next discusses the other roentgenologic signs of duodenal ulcer as follows:

1. Duodenal diverticulum.
2. Gastric hypertonus, hyperperistalsis and hypermotility.
3. Six-hour gastric residue.
4. Antral dilatation.
5. Gastrospasm.

With regard to Nos. 2 and 3, he states that a six-hour retention in a stomach with an unbroken contour, *i.e.*, without any roentgen evidence of gastric ulcer or cancer, should first of all suggest duodenal obstruction, the most common cause of which is duodenal ulcer. If, in addition to the gastric retention, there is typical gastric hyperperistalsis, the presence of a duodenal ulcer is well-nigh certain.

Radiographic Diagnosis of Metastatic Pulmonary Malignancy.—By A. B. Moore and R. D. Carman. (*American Journal of Roentgenology*, March, 1916, p. 126).—The paper is based on an analysis of 71 cases at the Mayo Clinic, examined independently both clinically and radiographically, and the combined findings tabulated.

In the series the site of the primary focus varied and both sarcoma and epithelioma are included.

The various clinical symptoms are discussed as to their frequency and significance.

The radiographic appearance, the writers believe, is quite typical and consists in the

localization of clear-cut circumscribed areas of increased density, varying in size from the head of a small hat-pin to that of an orange. Their density varies from a faint shading to a degree approximately equal to that of the heart, depending on the stage of the disease. These areas are usually multiple, are found most commonly near the hilus, and are usually situated nearer the base than the apices of the pulmonary lobes. All forms of malignant tumours apparently give the same appearance in the radiograph. One of the most striking features was the relative absence of any increase in the mediastinal shadow.

The differential diagnosis from inflammatory areas, tuberculosis, syphilis and cysts, particularly hydatids, is also discussed.

The conclusions formed are:—

1. Pulmonary metastatic malignancy is not an uncommon condition, and may occur regardless of the seat of the primary focus.

2. Pulmonary metastasis bears no relationship to the extent or duration of the primary focus.

3. The clinical picture in a majority of these cases is very indefinite, neither the subjective nor the objective manifestations being characteristic of the condition.

4. Metastatic pulmonary malignancy is a definite roentgenographic entity, appearing in the roentgenogram as clear-cut circumscribed areas of increased density.

5. In many instances the diagnosis can be established only by the roentgenogram. By routine roentgenographic examination of the thorax many patients suffering from malignancy will be saved from useless and unwarranted surgery.

The Use of the "Polygram" in Gastroduodenal Diagnosis.—I. Gerber (*American Journal of Roentgenology*, April, 1916, p. 220).—The writer states that his work on this line is an attempt to revive a method which has been lying dormant for several years.

His technique is to take two flash exposures, separated by an interval of usually eight seconds, on a single plate.

These polygrams are taken in both the erect and prone positions, and it is found that practically always, in one or other of these positions, the complete progress of the peristaltic wave can be shown.

In chronic gastric ulcer the area of induration will show definitely as a portion of wall that does not take part in the peristaltic conductivity. Craters or niches stand out prominently, and incisuræ, if present, show as permanent incuttings, easily distinguished from the criss-crossing peristaltic waves.

In duodenal ulcer the duodenal cap fails to expand completely, due to the localised cicatricial induration.

In gastric carcinoma filling defects will be observed, and complete absence of flexibility and motility in those parts of the wall infiltrated by the disease.

Gerber, in concluding, does not offer the polygram as a substitute for a very thorough and complete serial study, but he believes it will, in many cases, save considerable time, trouble and expense for those who mostly use plates in their study of gastro-duodenal disease.

The paper is well illustrated with several polygrams.

Diaphragming Roentgen Rays: Studies and Experiments.—H. E. Potter (*American Journal of Roentgenology*, March, 1916, p. 142).—An account is given of the writer's experiments with gratings designed to get rid of secondary radiations both from the tube and from the tissues being radiographed, and at the same time for the grating to be invisible on the resulting skiagram.

His conclusions are:—

1. The elimination of practically all of the rays not useful in practical roentgenography is made possible, even over large areas, by the use of composite tubular diaphragms so constructed and moved as to neutralize their own shadows.

2. Diaphragms of this type are useful both when mounted below the tube and below the patient.

3. Much needless time may be saved in experimenting on composite tubular diaphragming, if it is constantly remembered as fundamental that invisibility is only secured when each and every portion of the sensitive plate is successively covered and uncovered by the grating for equal periods of time.

Some Statistics on the Negative and Positive Roentgen Diagnosis of Gallstones. —J. T. Case (*American Journal of Roentgenology*, May, 1916, p. 246).—This is a detailed and critical study of 300 consecutive cases in which laparotomy was performed and the gall-bladder carefully examined at the time of operation.

With regard to cases where the Roentgen report is "suspicious of gallstones," Case says that no operation should be done unless the clinical findings would seem to confirm this suspicion.

It seems reasonable to conclude that, in at least some instances, the suspicious shadow was the thick-walled gall-bladder. In these "suspicious" cases the results show very plainly that the X-ray is of value in pointing out gall-bladder disease, even though a definite diagnosis of stones cannot be made.

In summarizing, Case finds there is considerable compensation for the fifty per cent. failure of the Roentgen method to make a definite diagnosis of gallstones in proved cases of cholelithiasis. In only four of thirteen cases of proved gallstones, when the X-ray examination was negative, did the X-ray report fail to give evidence of a gall-bladder lesion. In only three of the fourteen cases with the Roentgen report suspicious of gallstones, but where no stones were found at operation, was the gall-bladder found normal at operation.

We may conclude that it is possible to definitely show gallstones in fifty per cent. of positive cases, and to show Roentgen evidence of gall-bladder lesion in eighty-eight per cent. of cases of gall-bladder disease.

Case concludes by stating that gallstones are demonstrable with much greater frequency than has until recently been conceded, and that frequency is so great that the time has come when the X-ray examination should be required in every suspected case.

Roentgenographic Diagnosis of Pulmonary Tuberculosis.—K. Dunham (*American Journal of Roentgenology*, March, 1916, p. 131).—The writer has already described that what he regarded as the characteristic appearance in tuberculosis consisted of numerous abnormal changes limited to the linear markings of the various trunks seen in the lungs. These always reached the periphery, were more or less fan-shaped, with the apex of the fan toward the hilus, and the plate markings of the densities of the lesions were not homogeneous, but each trunk had a distinct characteristic marking.

He now further finds that these abnormal densities in the linear markings are due to tubercles situated along the bronchial tree; that the trunks represent larger bronchi with their accompanying vessels, and the linear markings the branches of these. He has been able to trace the spread of the disease along the bronchial branches, and states that the X rays will often give the first definite knowledge of the existence of the disease.

He also points out the prognostic value of radiography — cavitation and extensive involvements of the bases being of bad prognosis.

As this is only a preliminary report, one can only await in anticipation of the main body of the report.

Roentgen Diagnosis of Obscure Lesions of the Gastro - intestinal Tract.—W. H. Stewart (*American Journal of Roentgenology*, April, 1916, p. 202). — Stewart makes a strong plea for a thorough physical examination, with a complete history and record of laboratory reports to be combined with the findings of a complete Roentgen examination, before arriving at final conclusions.

To illustrate the need of such a procedure, he describes seven interesting cases of obscure lesions of the gastro-intestinal tract with the histories, clinical and physical signs, X-ray and operation findings, and remarks on each case.

Each case is illustrated with a skiagram showing the point in question, which helped in arriving at a diagnosis.

DENTAL RADIOGRAPHY.

Roentgenologic Examination in Elimination of the Mouth as a Source of Infection in Systemic Disease.—E. J. Eisen and R. H. Ivy (*American Journal of Roentgenology*, May, 1916, p. 269).—The authors describe their routine mouth examination under four headings:—

1. Clinical or visual examination.
2. Determination of response of each tooth to the Faradic current.
3. Roentgenologic examination (dental and accessory sinuses).
4. Microscopic or bacteriological examination of pus if indicated.

Their technique in radiography is fully described and illustrated, and the relationship between patient, physician, dentist and radiologist discussed.

The Roentgen Ray in Dental Practice.—A. H. Merritt (*American Journal of Roentgenology*, May, 1916, p. 264).—Probably the widest field of the usefulness of X rays in dental practice is in the light which it throws on infections at the apices of non-vital teeth. Such infections frequently occur which the most painstaking examination, unaided by the roentgen ray, fails to reveal. Not until its introduction was there any idea of the frequency and extent of these infections, and the result has been to revolutionise the treatment of these cases.

Radiography has shown these infections to be progressive, beginning as a slight rarefaction of limited area at the root end, which may in time greatly increase in size, causing complete solution of bone with cavity formation, which, in the case of the so-called blind abscess, has no direct communication with the mouth. A differential diagnosis between the fistulous and blind dental abscess cannot be made by the roentgen ray. Nor does the radiographic and clinical examinations always agree. An insignificant rarefaction may be, clinically, an active fistulous abscess of long standing. Serious secondary infections may result from a non-vital tooth which radiographically appears normal.

It cannot be too strongly emphasised that a correct interpretation cannot, therefore, be made by one unfamiliar with the clinical history of the case.

The first requisite to the successful treatment of these abscesses is the removal of the gangrenous tooth pulp, sterilization of the root canal and filling of same to the end—preferably with a material impervious to the roentgen ray. To accomplish this it is desirable to make an X-ray examination of the tooth before treatment is begun, a second examination after it has been cleansed and sterilized, with a wire in place to make certain that it has been properly prepared, and a final examination after the root filling has been made, to make sure that it extends to the end and seals the root. Without X rays, it is impossible in any given case to be certain that the operation has been properly performed.

With regard to pyorrhoea alveolaris, it is pointed out that the loss of bone frequently takes place on one or two sides only of the four root surfaces, so that the radiographic appearance may be misleading.

Little nodular osseous deposits may form in the body of the pulp and cause facial neuralgia, while hypercementosis or bony enlargement of teeth roots may also cause ill-defined pains. Both of these conditions can be demonstrated radiographically.

The paper is illustrated with excellent radiograms.

The Apical Shadow (Dental).—G. M. MacKee and J. Remer (*American Journal of Roentgenology*, March, 1916, p. 171).—The writers point out that a dark shadow in the skiagram around the apex of a tooth may be the result of infection, usually from a dead tooth, or a blind abscess with a healthy tooth. The diagnosis, however, should not be made by the radiographer alone, but, as the writers remark, in conjunction with the dentist, who will apply the suitable clinical tests.

Not infrequently a dentist will locate a dead tooth by either objective or subjective symptoms, and will be greatly surprised when the skiagram fails to demonstrate any abnormality. In such a case the infective process may not have involved the alveolus, or, if it has, the amount of decalcification may be so slight as not to be noticed radiographically.

It is pointed out that considerable caution is required in interpreting very slight apical shadows. Anatomical shadows, photographic defects, artifacts and overlapping shadows must be carefully excluded. The overlapping shadows from the antrum in the case of the superior molars, the foramen of the inferior dental canal in the case of the lower bicuspids, and the nasal cavity in the case of the superior

central incisors may simulate apical shadows. It is considered extremely risky for the radiographer to diagnose the presence or absence of pus.

The paper is illustrated with excellent reproductions from films, showing the difficulties of interpreting the apical shadow.

The authors conclude with a plea for the co-operation of the skilled dentist and the expert radiologist.

RADIOTHERAPY.

Treatment of Carbuncles by the Roentgen Ray.—K. Dunham (*American Journal of Roentgenology*, May, 1916, p. 259).—The writer reports the successful treatment of 67 consecutive cases. He describes his technique and states that within less than 48 hours the entire clinical condition of the patient has changed.

Apparently, it is the streptococcic infections that receive the most benefit.

The writer concludes by saying that nothing in all roentgentherapy gives such positive and uniformly perfect results as the treatment of a carbuncle.

The Comparative Value of Roentgen and Radium Radiation in Therapeutics.—W. S. Newcomet (*American Journal of Roentgenology*, April, 1916, p. 208).—The writer finds that in cavities radium is better, while in recurrent carcinoma of the breast roentgen radiation is much to be preferred. Keloid is better treated with X rays, and corneal scars and pannus following trachoma have shown excellent results with this radiation. Post operative radiation is suggested for non-malignant diseases of the uterus, such as fibroids.

In radium treatment he has reason to think that the effects are due in part to the β ray, even when heavy filters are used.

In conclusion, Newcomet says it might be fairly stated that an exact comparison of the two forms of radiation is extremely difficult, due to the wide difference in technique, and the wide variation of results reported by various writers in both fields ; this is further confused by the fact that many individuals employing these radio-active elements have had very little experience in general radiology. From personal experience and observation, however it still appears that there is and will be a field for both forms as well as a very broad common ground where both will yield results equally depending entirely upon the individual technique.

Preliminary Report on Roentgen Studies of the Effect of Moderate Doses of some of the Opium Derivatives upon the Gastro-intestinal Tract of Man.—H. K. Pancoast and A. H. Hopkins (*American Journal of Roentgenology*, April, 1916, p. 211).—It is pointed out the enormous amount of valuable work yet to be accomplished in connection with the study of drug action by the Roentgen examination, and also that English literature is noticeably lacking in this field of investigation.

The Roentgen examination is a valuable method of studying certain phases of drug effects upon the gastro-intestinal tract, especially motility.

With morphine there is a decided lack of uniformity in the effects produced in different individuals in connection with both stomach and bowel. There is no distinct uniformity in connection with dosage. Small doses in some may produce more marked effects than much larger doses in others. Females appear to be more susceptible.

In most cases the stomach shows more or less pyloric spasm, increased peristalsis, and a decided prolongation of the emptying time. In the small intestine morphine causes decreased motility almost uniformly, apparently as a result of a lack of propulsion, and not of spasm. When marked, it is most noticeable in the upper small bowel.

The effect upon the large bowel is very variable, and probably of little consequence.

Oral and subcutaneous administration produce practically the same effect.

Roentgen Symptomatology of Pulmonary Tuberculosis. — F. S. Bissell (*American Journal of Roentgenology*, March, 1916, p. 139). — In the writer's opinion a positive tuberculin reaction and the presence of a peripheral interwoven appearance of the pulmonary striæ go hand in hand. As to the

pathological cause of this fine interweaving, he states that when the bacillus tuberculosis lodges in the tissues it always becomes surrounded by endothelial leucocytes or cells of a similar character, to form a tubercle. These cells continue to multiply until they have obliterated, by actual encroachment, the tiny bronchioles and arterioles in the immediate vicinity, and he asks whether this alteration in structure may not cause the bronchioles and arterioles to become less radiable and thus produce a linear radiation about the tubercle itself.

Bissell has not observed any characteristic differences between the early Roentgen manifestations of tuberculosis in children and in adults, except a tendency toward complication by broncho-pneumonia in children and by pleurisy in adults.

His conclusions from an analysis of many cases are:—

1. The tuberculous lesion, very early in its development, presents certain distinctive characteristics recognizable in the roentgenogram.

2. The differentiation of symptom - producing from non-symptom-producing tuberculous lesions is a clinical as well as a roentgenological problem.

3. The roentgenogram frequently presents the only objective signs of the disease, and a Roentgen study of every case is of the utmost importance from the standpoint of diagnosis and of prognosis.

4. The co-ordination of positive roentgenographic data and the constitutional tuberculin reaction is significant.

Roentgen Deep Therapy in Malignant Tumours.—A. F. Holding (*American Journal of Roentgenology*, April, 1916, p. 191).—Holding describes fully the treatment and course of some of his cases of deep-seated malignant disease, and is able to record 6 to 7 per cent. of symptomatic recoveries in inoperable and hopeless cases.

He forms the following conclusions:—

1. The most important point in connection with the use of physical methods for therapeutic purposes is that they aid nature to cure superficial malignant tumours much better than surgical methods.

2. Under Roentgen deep therapy it is a common occurrence to have tumours undergo retrograde metamorphosis or even to disappear.

3. In hopeless cases these physical methods enable nature to effect marked amelioration of the symptoms.

4. Occasionally this amelioration of symptoms amounts to a symptomatic cure.

5. The amelioration of symptoms is distinctly worth while.

6. If these physical methods ameliorate the symptoms in hopeless cases, patients having operable lesions should not be denied the benefits of these physical methods after operation.

7. Two forms of tumours, not previously reported in medical literature, are markedly ameliorated by Roentgen deep therapy, namely, carcinoma testis of teratoid origin and carotid gland tumour.

8. Every effort should be made to perfect the technique and the use of adjuvants to increase the number of symptomatic cures and make permanent the ameliorations.

A NEW CATALOGUE.

We have received from Messrs. Frederick R. Butt & Co., Ltd., a copy of Section "B" of their new catalogue, covering tubes and accessories for radiography and X-ray treatment. The list, which consists of 148 pages, and over 300 illustrations, provides a very full range of apparatus for the X-ray worker, many of the articles being specialities of the firm. The catalogue also includes useful and lucid advice on the management of tubes, hints on developing, and the principles of localization, with descriptions of all the best known methods. A copy of the list may be had gratis on request to Messrs. Butt, at 147, Wardour Street, London, W.

PUBLICATIONS RECEIVED.

Books.

Manual d'Electrothérapie et d'Electrodiagnostic. Par le Dr. E. Albert-Weil. Paris: Librairie Félix Alcan.

Précis d'Electricité médicale. Par E. Castex. Troisième Edition, revue et augmentée. Paris: J. Lamarre.

Radiodiagnostic des Affections Pleuro-Pulmonaires. Par F. Barjon. Paris: Masson et Cie.

Skin Cancer. By Henry H. Hazen, A.B., M.D. C. V. Mosby Co., St. Louis, Mo., U.S.A.

The Pathology of Tumours. By E. H. Kettle, M.D., B.S. London: H. K. Lewis & Co., Ltd.

The Student's Textbook of Surgery. By H. Norman Barnett, F.R.C.S. London: William Heinemann.

Journals.

American Journal of Electrotherapeutics and Radiology, Sept., 1916.

American Journal of Roentgenology, Sept., 1916.

American Medicine, Sept., 1916.

Archives d'Electricité Médicale et de Physiothérapie, Sept. 25th, 1916.

Archives de Médicine et de Pharmacie militaires, Aug., 1916.

Boston Medical and Surgical Journal, Sept. 21st, 28th, Oct. 5th and 12th, 1916.

British Journal of Dermatology, July-Sept., 1916.

British Journal of Surgery, Oct., 1916.

Bulletin of the Johns Hopkins Hospital, Oct., 1916.

Cleveland Medical Journal, Aug., 1916.

Gaceta Médica Catalana, Sept. 30th, Oct. 15th, 1916.

Interstate Medical Journal, Sept., 1916.

La Radiologia Medica, Sept.-Oct., 1916.

Maryland Medical Journal, Oct., 1916.

Medical Journal of Australia, July 1st, Aug 12th, 19th, 26th, and Sept. 2nd, 1916.

Medical Record, Sept. 16th, 23rd, 30th, and Oct. 7th, 1916.

Medical Times, Oct., 1916.

New Orleans Medical and Surgical Journal, Oct., 1916.

New York Medical Journal, Sept. 16th, 23rd, 30th, and Oct. 7th, 1916.

New York State Journal of Medicine, Sept. 1916.

Norsk Magazin for Lægevidenskaben, Oct., 1916.

Policlinico, Sept., Oct., 1916.

Revista Española de Electrologia y Radiología Médicas, Aug., Sept., 1916.

Southern Medical Journal, Oct., 1916.

Ugeskrift for Læger, Oct. 5th and 12th, 1916.

Urolog ic and Cutaneous Review, Sept., 1916

NOTICES.

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Contributors of original articles, whether illustrated or not, will be furnished with 50 reprints free of cost. All radiographs and photographs must be originals, and must not have been previously published.

Advertisements.—Whole page, £5 net; half page, £2 15s. net; quarter page, 30s. net; eighth of a page, 17s. 6d. net. Series discounts, 10 per cent. on six, 20 per cent. on twelve insertions during the year. All copy must be received by the 18th of the month to take effect in the next issue.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

X-RAY APPEARANCES IN GAS GANGRENE.

By Agnes Savill, M.A., M.D. (Glasgow), M.R.C.P. (Ireland).

Physician to London Skin Hospital and to Electrical and X-Ray Department, Scottish Women's Hospital, Royaumont, France.

The most terrible of all the horrors which come under the care of the surgeon in this war is undoubtedly gas gangrene. Dramatic in the suddenness of its onset, the rapidity of its advance, and the repulsiveness of its too frequently fatal outcome, it has reaped a cruel harvest of our young and vigorous manhood. Throughout the laboratories of Europe the bacteriologists are working to discover its cause and thus arrest its work of destruction. Just as tetanus, before the knowledge of the bacteriologist, has practically ceased to be seen in military hospitals, so in the future we trust that gas gangrene may be checked. At the present time so many germs are detected in the infected tissues that it is impossible to assign specificity to any one organism in particular. The depth of tissue invasion, the kind of tissue attacked—subcutaneous tissue, muscle, or blood-vessel—may prove to be as important factors

in determining the benign or fatal issue as the variety of invading hostile microbe. It is now well established that even when the most dangerous organisms are present in a superficial wound, the patient, with early and adequate treatment, may run an uneventful progress to recovery; while with the same germ of infection another man, treated a day too late, may have his deeper structures so involved that nothing can save his life. Research at present is directed to ascertain the direct and the contributory causes of the two types of gas gangrene—the localised and the massive forms.

At the Scottish Women's Hospital, Royaumont, France, of the cases admitted between July 1st and mid-September (1916), no fewer than 304 contained the organisms of gas gangrene, and in over 100 of these there were definite clinical evidences of gas. Royaumont is situated only twenty-five miles behind the firing line, and cases reached us a few hours after being wounded, when sent direct from the front, and two or three days later when they had been detained for rest in hospitals nearer the front. We had received warning that the offensive was to begin about the end of June, and when we heard the guns thundering by day and by night from the twenty-fifth of June we realised that our share in the labour entailed by all military operations was about to commence. On July 2nd the anticipated rush began, and for ten days, almost without intermission, it continued.

It was our rule that every case was examined on admission by a surgeon, and a specimen sent at the same time to the bacteriologist. Cases with clinical signs obviously demanding immediate surgical intervention, were taken to X-ray room and operation theatre with as little delay as possible. No matter at what hour of the day or night the wounded *poilus* arrived that procedure was invariably followed. Cases which did not present any clinical evidence of gas, but whose wounds were reported to contain anærobic infection, were operated upon, other things being equal, in precedence to cases with simple septic organisms. There can be no doubt that this rule of action was the means of aborting the course of gas infection, and thus saved both limbs and lives. By the autumn two outstanding facts were clear; cases arriving within 24 hours of being wounded were usually soon on the convalescent list; whilst those wounded three or four days previously and similarly infected, frequently succumbed, or lived only when a limb had been removed.

By the end of July I had definitely concluded that the X-ray plate was of great value to the surgeon, in revealing both the presence of gas and its extent and situation. But unfortunately it was not until September that I learned that the radiologist could also yield valuable aid, in the absence of a bacteriologist, by reporting in some cases the variety of gas infection. The surgeon can rely on the positive finding of the radiologist in much the same way that the physician can rely on the bacteriologist when diphtheria is found in a suspicious throat. The causes of failure to obtain good plates are so numerous from over or under-exposure, from over and under-development, that no reliance can be placed on a negative skiagram; but when a skiagram reveals the presence of gas there are but few fallacies (readily eliminated)

and the surgeon can gauge the extent, the depth, and also, I believe, in a large proportion of cases, the variety of anærobe at work.

I gratefully acknowledge that I owe the recognition that it is often possible to detect the variety of invading germ to Dr. Pech, that enthusiastic and original radiologist, who was in charge of the X-ray department of the military hospital at Creil. He showed me a large number of remarkable plates, with fine striation, which demarcated the individual muscles so that

Fig. 1.—Pale misty swelling frequently found with perfringens infection. Free incisions ; good recovery.

they resembled a sketch made in black and white. He had found that such an appearance was always associated with the vibrion septique, and that the outlook for the patient was of the gloomiest. In all the cases at Royaumont I could only find two with the same fine striation. Both died within twenty-four hours, but the vibrion septique was found in only one of these. As Dr. Pech's X-ray room is situated close to the evacuation station he probably

received many more of the men taken from the train who were too ill to travel even the few miles in an ambulance to our hospital. Dr. Pech is shortly to publish his careful and unusual observations in the French journal of radiology.

As soon as I had seen these plates at Creil I made an analysis of the plates at Royaumont, noting the X-ray appearance, the bacteriological report, and the

Fig. 2.—Swelling and cloudy outline. Position of Metallic fragments shows extent of swelling at site of wound. B. Perfringens and B. Sporogenes. Recovery with complete use of arm in 2½ months.

surgical finding. Professor Weinberg, of the Pasteur Institute, whose name is associated with gas gangrene research, was a frequent visitor at Royaumont and gave every possible assistance in our laboratory.

Of 100 plates taken, there remained only sixty-seven on which it was possible to make a report. Some had been lost, some broken, others were too thin from under-development and hard tubes to yield information adequate to

base an opinion upon. Others were in such situations as the trunk and the hand; in the former the ribs or the density of the part, in the latter the amount of bone present, concealed the gas outline in these particular cases in such a way that one could not give any reliable information.

Three totally distinct appearances were observed in the plates which gave positive evidence of gas, and with few exceptions these corresponded to three different forms of anærobic infection. Whether this is always true can only be decided by future observations. Of course it is known that a multiple infection is usual; the question at issue is: can the radiologist assist the surgeon and the bacteriologist by indicating which anærobe has the upper hand?

The first two appearances were common, the third rare. (1) Simple swelling, with a pale misty outline which sometimes fades a little in indefinite areas in much the same way that a white fog fades in a landscape. The degree of the swelling gives some evidence of the amount of infection present. This form is found when B. perfringens is the chief organism, and is probably due to the œdema, which is usually associated with B. perfringens. A woman with œdema of one side of her arm showed just the same pale misty hue in the situation where clinical evidence of œdema existed.

(2) Swelling, and in addition a cloudlike outline, an appearance as if the flesh were replaced by dark woolly clouds. This aspect is due to infiltration of the tissues by the gas. In some cases there are seen rounded or oval-shaped dark outlines, where the gas is sharply demarcated. The diffuse cloudiness is the more common variety by far. For a long time, when a group of gas bubbles, about the size of a threepenny bit, occurred in close proximity, I believed the picture was due to a plate flaw. The diffuse cloudiness was in the great majority of cases associated with B. perfringens and B. sporogenes together. I understand that "sporogenes" includes the "malignant œdema" of some writers.

(3) Striation. This third appearance was exceedingly rare. There were two types—coarse and fine. The fine striation occurred in only two of our cases, but Dr. Pech has a large collection of plates illustrating this rare condition. The dark lines of gas infiltration map out the individual muscle fibres in such a definite manner that the plate resembles a drawing of the muscles of a limb.

The coarse striation was also rare (15 cases). It was usually associated with considerable swelling, whereas the fine striation cases were not so swollen at the time of the skiagram as their serious clinical condition would have led one to expect. The coarse striation occurred in limited areas; the lines of division were straight and were always seen in a longitudinal direction. The intensity of the infective process seemed to cause dissociation of groups of muscle fibres in an area which was usually about two inches long, but I show prints of cases which present the striation along the greater part of the limb.

In one of the cases of fine striation, fully detailed below, the vibrion septique

and B. perfringens were found in the depth of the muscles and in the blood. In the other, B. histolyticus and B. fallax were the uncommon germs present. Both cases were fatal. In the cases with coarse striation, B. œdematiens and B. Hibler IX were the most frequently occurring organisms.

Fallacies to be avoided are:—(1) Actual loss of tissue, which is frequent with the extensive wounds of present-day warfare, causes a dark irregularly outlined aspect, which may mislead the radiologist who has not seen the wound, but cannot possibly mislead the surgeon. (2) I have seen an extensive ecchymosis give the swollen misty and fading-away appearance exactly resembling the common œdematous perfringens infection. I have not seen numerous enough cases of ecchymosis to be in a position to state whether it can be distinguished from the perfringens invasion, but there could not be any clinical difficulty in the differential diagnosis. (3) I believe abscesses may simulate gas bubbles. As B. perfringens is so all-prevalent in military surgery to-day, it is difficult to say whether in these abscesses some gas was not present. In any case the indications for the surgeon are similar in both cases.

Perhaps, when speaking of fallacies, it is well here to emphasise the fact that no reliance must be placed on negative plates. Two cases occurred which forcibly impressed this truth on my mind. Both men had been wounded in the region of the hip, and the skiagrams revealed nothing abnormal in the dense area of flesh in the neighbourhood of the joint. Both developed gas a few days later and died. On the other hand, it is only fair to say that two plates without abnormality, plates of patients who afterwards developed gas, were taken about a week before death. In most of the fatal cases the positive skiagrams had been taken within two to four days of death. These negative skiagrams therefore may have been negative because at the date they were taken only gas infection, without gas formation or gangrene, was present.

Prognosis and Bacteriological Analysis.—These paragraphs must only be regarded as a tentative contribution to a very complicated subject. So many factors have to be taken into consideration with each individual, that the plate of the radiologist is only one of the evidences which have to be duly weighed by the surgeon. In brief, (*a*) the first type, that with simple swelling, is usually, I believe, the most favourable for recovery provided correct surgery is resorted to immediately. Except where the swelling was very extensive—as, for example, along an entire forearm or leg—the course after free incisions and adequate after-care was in most cases uneventful. Where the general condition is not good on admission, owing to lack of resistance to the toxin, the surgeon watches the case, on the alert to amputate if need be.

Of twenty-six plates showing only simple swelling B. perfringens was the only anærobe present in twenty-five cases; B. sporogenes accompanied it in one.

(*b*) Where the second type is present, with swelling and cloudy tracing, the course towards recovery may be steady after free incisions have been made.

Fig. 3.—Cloudy tracing showing deepseated and extensive gas infiltration. Extended upwards in spite of amputation; death ten days later. Clinically: crepitant, brawny swelling; yellow œdema and dark red gangrenous muscle.

Fig. 4.—Fine Striation. Skiagram taken three days after wound. Fatal issue next day. B. Perfringens and vibrion septique.

X-RAY APPEARANCES IN GAS GANGRENE.

By Agnes Savill, M.A., M.D. (Glasgow), M.R.C.P. (Ireland).

Plate 22.

Where the cloudiness indicates deep-seated gas, unrecognisable clinically, the outlook is exceedingly serious, and when in such a situation that amputation or other operative measures cannot reach the infection to stem its advance, death ensues.

Of twenty-four plates showing both swelling and cloudy tracing, B. perfringens was the sole anærobe in three cases; B. perfringens and B. sporogenes were associated in twenty-one cases; and in four the graver

Fig. 5.—Coarse Striation. Skiagram taken day after wound. Fatal issue same night.

organisms, such as usually caused some degree of striation, were detected—B. œdematiens in three and B. histolyticus in one.

(*c*) When striation is present, fine or coarse, in my limited experience the prognosis is very grave. Our two cases with fine striation died with rapid massive gangrene. Of fifteen with coarse striation, six died in spite of amputation and every care; six lived after amputation; three had extensive

removal of gangrenous muscle. In those three and in one requiring amputation (Fig. 6) no other anærobes than B. perfringens and B. sporogenes were found. In the other cases with striation dangerous anærobes such as the vibrion septique, B. œdematiens and B. Hibler IX were present.

Fig. 1 is an example of a simple B. perfringens infection. It shows the considerable degree of swelling and the pale misty appearance which is probably due to the yellow œdema so usually associated with B. perfringens. The pale aspect of these plates often resembles the skiagram produced by a hard tube and over exposure. Where the swollen area is not too extensive free incisions, without amputation, bring about cure.

Fig. 2 is typical of many cases with a mixed B. perfringens and B. sporogenes infection. It was taken on admission, the day after the wound. The swollen muscles protruded from the foul wounds, and the general condition was serious. The torn gangrenous muscle was cut away and free incisions were made from elbow to wrist on both flexor and extensor aspects. Two and a half months later, assisted by galvanism after the wounds had healed, the man had practically perfect movement of the arm.

In this print the swelling and cloudy tracery are typical of the double infection. In such cases the prognosis was good when admitted before a general poisoning of the system had taken place, and when the local gas was not too deep-seated.

Fig. 3 shows the same infection, but deep-seated, as far as the bone, and extensive, being diffused over almost the entire leg. The appearance is characteristic of the double infection. There was crepitant swelling and yellow œdema, and gangrenous muscle. In spite of amputation the gas spread upwards. Re-amputation high up in the thigh could not arrest its progress, and death followed in ten days. A skiagram taken of the amputated thigh muscles showed no striation present.

Fig. 4 is characteristic of the fine striation which, I believe, is a herald of the most serious condition. A. S., a Senegalese lad of twenty, was admitted with a temperature of 100° F. and a running pulse of 126. He had been wounded three days previously in the right leg, and at the field hospital the shattered fragments of the right fibula had been removed the day after the wound. On arrival at Royaumont the leg was somewhat swollen and cold, and the general condition aroused anxiety. Within two hours the leg had been amputated high up in the thigh. The muscles in that position did not appear unhealthy. Professor Weinberg happened to be at Royaumont that day, and four hours after admission the patient received a dose of Weinberg's serum—a mixture of anti-perfringens, vibrion septique, and œdematiens. The pulse and temperature improved, and next morning the stump looked healthy. The patient became restless during the day, and the temperature and pulse began to rise. About six o'clock he seemed delirious, sat up in bed talking, then fell back in a syncope, from which no stimulant nor even the intravenous saline could rouse him. Before seven he was dead, and then it was noted

that the stump had swollen to thrice its size. Early the next morning it was almost impossible to place thé distended body into a coffin.

Both in the muscles of the amputated leg and the swollen stump after death, and also in the blood, there were found B. perfringens and the lethal vibrion septique.

Figs. 5 and 6 are excellent examples of coarse striation. There were only three of this type in which the coarse striation extended so widely, from one joint to another.

FIG. 6.—Coarse Striation. Skiagram two days after wound. (Artery injured and red degenerated muscle). On 3rd day arm blue, cold and swollen. Amputation saved life.

Fig. 5.—This patient arrived late at night in a very serious condition. Amputation was performed at once, but he succumbed in a few hours. Examination of the limb showed that the gangrenous muscle corresponded to the area of striation seen in the skiagram, and where the normal shadow is seen the muscle was not much affected.

Fig. 6 is an example of a case in which the skiagram revealed serious trouble about thirty hours before the clinical signs became severe. The man had not much swelling of the forearm on admission. The wound was opened up freely and the foreign body removed; the artery was discovered to be injured and was ligatured. I was at that time (early in July) unaware of the importance of a skiagram showing striation, and therefore no particular notice of it was taken. A day and a half later the forearm was found to be cold and discoloured and greatly swollen. Amputation was performed immediately, and the patient made a steady, uneventful progress towards recovery.

The bacteriology of both these cases was simpler than in the majority of cases with striation. In the first there were found only B. perfringens and B. sporogenes. Yet the skiagram has none of the cloudy tracing which was so commonly found with this combination. (Cp. Fig. 3.) In Case 6 B. perfringens and streptococci were found. Possibly the injury to the artery had something to do with this unusual form of gas permeation in a condition showing perfringens and streptococci alone.

Another case may here be cited to prove the prophetic value of the skiagram. The patient arrived on a Saturday evening, and the plate taken on admission revealed a cloudy tracery over almost the whole area of the thigh which was visible on a 12 by 10 plate. In one corner there was slight but unmistakable coarse striation. Now the wound was three days old, but apparently superficial. A piece of shell had glanced across the anterior surface of the thigh, tearing away a portion of skin. I did not then realise the importance of the skiagram, but when I showed it to Dr. Pech two days later he gave a gloomy prognosis. On the evening of admission the wound had been freely opened and pieces of gangrenous muscle had been removed, the discovery of which had put the surgeon on the alert lest danger should ensue. For two days all apparently went well. Then the whole thigh swelled up. A circular amputation was performed, but the patient died next day (Thursday) with gas extending up the trunk. The bacteriological report mentioned perfringens, sporogenes, and œdematiens. Had it been realised that Saturday's skiagram revealed deep-seated gas far above the site of the wound, the surgeon would have taken more stringent measures from the first.

THE RECOGNITION OF GAS WITHIN THE TISSUES.

By H. Martin Berry, M.D., Radiologist, Royal Herbert Military Hospital, Woolwich.

One of the many important subjects which the war has thrust upon the notice of the medical profession is that of the action of the various groups of anærobic bacilli. A prominent effect of certain of these micro-organisms is the formation of gas within the tissues of the living body, and it is the detection of this gas, and therefore of the presence of the bacilli, which forms the subject of this communication.

The number of deaths which have already occurred as the result of anærobic infection makes the subject of great practical importance, especially so since, as is the case in all bacterial infections, early diagnosis is the first step towards favourable prognosis.

If a wound merely be infected by anærobes without the formation of gas bubbles, radiology, so far as we know at present, can be of no assistance towards diagnosis, but, if gas be present in the tissues, it can be demonstrated in a well made radiograph. Not only its presence, but also its exact location, can be depicted, and thus we can help the surgeon in deciding what course of treatment to pursue.

In two at least of the following cases there were no symptoms suggestive of gas gangrene, as the process had not advanced to such a stage that either local signs or systemic disturbances had manifested themselves, but the early recognition of the presence of gas led to prompt surgical intervention followed by rapid recovery.

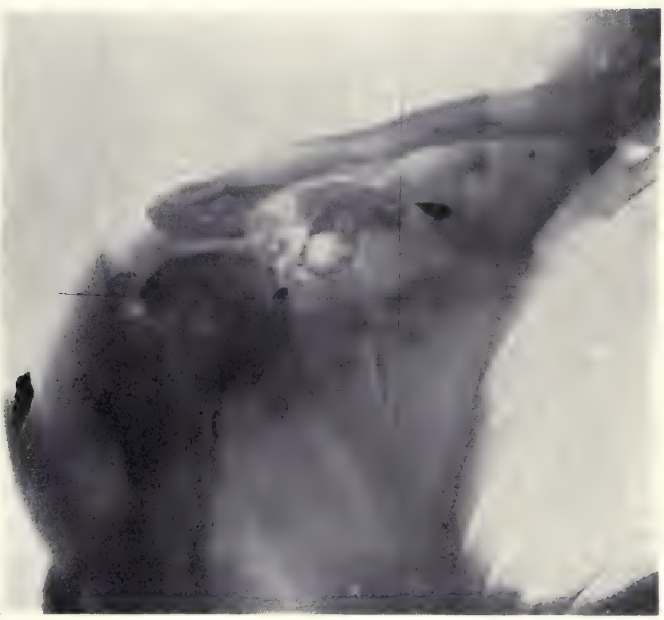
When gas has been formed in the body as the result of fermentation of muscle sugars consequent on anærobic infection, it frequently happens that it has no method of escape and therefore acquires a positive pressure which is sometimes considerable. This pressure tends to increase the infected area either, according to one theory, by limiting the blood supply of the part, or, according to another theory, by splitting up the tissue planes and thus laying open fresh avenues for infection. We need not concern ourselves with considering which of these theories be correct, since in either case the effect is the formation of more gas resulting in a further increase in pressure, and thus a vicious cycle is established—perhaps the most potent argument for the necessity for early diagnosis.

In order to give some idea of the frequency of these cases, even at a hospital in England, those only have been included in which a diagnosis of gas formation has been made during a period of three months. Such cases, naturally, will be more common at our various hospitals in France. Many patients known to be infected with gas-forming organisms have been operated on abroad and the gas liberated, so that they show no radiographic evidence of gas formation on their arrival here. Despite this there are 28 cases to be included.

In practically all of the cases there is surgical or bacteriological evidence to substantiate the diagnosis. For the surgical notes I am indebted to Captains Jocelyn Swan and Cecil Rowntree and for bacteriological information to Dr. Kenneth Goadby.

In most of the examples of diffuse infiltration clinical examination gave unmistakable evidence of the condition by tissue crepitation, but, even in these cases, radiography was useful to localise the area affected. In the cases with only a few discrete bubbles nothing abnormal could be felt.

In a few instances limbs were dissected after amputation to check the diagnosis and in each case it was confirmed.



Case 1.

The extent of tissue damage bears no necessary relation to the presence of gas; it was found in small punctured wounds as well as in large lacerated ones. In some cases the gas bubbles were not in the direct track of the wound and had apparently moved along the path of least resistance.

Nor does the smell of any discharge which may be present act as a guide, as gas was found not only in those with foul discharge, but also in instances where it was quite sweet or absent altogether.

Radiographically speaking there are two main types of gas formation:—

1. Where there are a comparatively small number of discrete bubbles, though individual ones may be of large size.
2. Where there is an extensive and diffuse gas infiltration. In either condition the gas may be found under considerable pressure. Further experience may lead to extension of this classification.

There are certain fallacies to be guarded against in making a diagnosis of the presence of gas:—

1. The actual wound may involve such a loss of tissue as to cause increased radio-transparency of the part. This is very common, but is easily distinguished and is hardly likely to lead to error.

2. Bubbles of air may be trapped within the tissues. This is not so common, and the shadow outline is apt to be less defined. There is only one case in the series where this diagnosis was suggested.

3. If the wound has been syringed with peroxide of hydrogen, oxygen bubbles may be present under considerable tension. Enquiries should be made, therefore, as to whether the wound is known to have been so treated and due caution exercised. This is particularly the case when the bubbles are few and discrete, and, in the present state of our knowledge, there is no certain means of differentiation, though if the gas be situated at some distance from the track of the wound it is more likely to be the result of the infection than of the treatment. In diffuse infiltration this is practically certain to be the case and diagnosis can be made with confidence.


Case 2.

Case 1.—The radiograph was taken four days after the wound was inflicted. It shows several discrete bubbles together with a fair amount of diffuse infiltration. As will be seen, there is extensive bone damage.

Clinical notes. Wound very foul, crepitation felt in the tissues, radial pulse normal on the affected side.

Surgical Notes. The part was freely opened up and drained and the man improved for several days, Later, the head of the humerus and the glenoid were removed along with much bone debris. The bone was soft, blackened and foul. The patient is doing well.

Bacteriological notes. A smear preparation taken at the first operation showed sporeforming bacilli of the malignant œdema type.

Case 2.—The radiograph, taken on the fifth day, shows extensive and diffuse gas infiltration of the calf without any bone damage.

Clinical notes. The inner and posterior portions of the leg were distended and crackled on pressure, but the swelling did not extend into the thigh. Toes just warm, no pulse in dorsalis pedis or posterior tibial arteries.

Surgical notes. A long incision was made in the leg in the region indicated and gas escaped under considerable pressure. The gas had lifted the subcutaneous tissues off the muscles but the muscles themselves were not emphysematous. The smell was very foul and the condition so bad that amputation was performed.

On the following day he had secondary hæmorrhage from another wound in his arm and the third part of the axillary artery was ligatured. The next day gangrene of the arm developed with much emphysema, and the arm was amputated at the axillary fold, but the emphysema spread to the chest wall and he collapsed and died, mentally clear to the end.

Bacteriological notes. A swab taken at the first operation showed a mixed infection of perfringens, malignant œdema, staphylococci, streptococci and rodella.

Case 3.—The plate, taken eight days after the wound was received, shows diffuse gas infiltration around and behind the greater trochanter and extending down the thigh.

Clinical notes. This man had had an operation in France. A drainage tube had been inserted and the wound sutured round it. On admission, the wound was very foul, the skin dusky and tense, and emphysema was felt on pressure.

Surgical notes. Operation the same day as the radiograph. The deep fascia had been lifted off the muscles by gas, which was under great tension and spurted from under the ilio-tibial band, but the muscles themselves were not emphysematous. The patient appeared to be doing well after operation, but he suddenly collapsed and died two days later.

Post-mortem changes were very rapid; 12 hours after death the whole body was blackened and much swollen; in 36 hours distension was so great that the skin cracked in all directions and much fluid exuded. So great was the distension that it actually bulged out the sides and forced off the lid of the coffin in which he had been placed, and a larger one had to be obtained.

Case 4.

Bacteriological notes.—The infection was a mixed one of perfringens, lactis ærogenes, malignant œdema, Hibler, streptococci and staphylococci.

Note. This case and the preceding one are the only two deaths in the series of 28 cases, and the similarity between them is very marked. In both there was a mixed infection, in both there was an extensive diffuse infiltration by gas, and the connective tissues were lifted off the underlying muscles, in both the smell was foul.

Case 4.—The plate, taken five days after infliction of the wound, shows a large metallic fragment in front of the elbow and a large single bubble of gas in its immediate region. Damage to the external condyle of the humerus was also observed.

Clinical notes. There was no evidence of gas formation, but the whole area surrounding the wound was very tender and the man complained of great pain on the slightest movement. In his other forearm he had a fracture of both bones, but this could be handled freely without pain.

Surgical notes. On operation the gas was found under considerable pressure, the external condyle was found to be separated and damaged and was removed, as was also the metallic fragment. He is doing well.

Bacteriological notes.—The infection was perfringens, proteus and streptococci.

Case 5.—Radiographed three days after being wounded. The plate shows gas bubbles deep in the tissues of the back of the thigh.

Clinical notes. The wounds were small and healing rapidly. The part was not markedly tender and there was absolutely no suspicion of infection by anærobic bacilli.

Case 5.

Case 6.

Case 7.

Case 8.

GAS WITHIN THE TISSUES.
By H. MARTIN BERRY, M.D.

PLATE 23.

Surgical notes. Operation was performed as soon as the presence of gas was reported. A long incision was made and a cavity found which was full of recent blood clot; this clot was disintegrating and contained gas in its interior.

Bacteriological notes. The clot showed a very extensive infection with perfringens. The surroundings were particularly favourable for the growth of anærobic bacilli, and, had the infection once passed beyond the limits of the clot, acute gas gangrene was inevitable. This was averted by prompt treatment.

The patient made an uninterrupted recovery and has now been discharged from hospital.

CASE 6.—Radiographed on the third day and an extensive gas infiltration seen behind the knee. He did well after free incisions.

Bacteriological notes. The infection was perfringens and diplococci.

Case 9.

CASE 7.—Radiograph taken three days after the wound shows a large metallic fragment deeply placed behind the knee joint and a large single gas bubble in the same region. The gas was found to be under high tension.

The patient did well. No bacteriological examination was made.

CASE 8.—Radiograph taken on the ninth day shows a single large bubble in the tissues of the neck.

Clinical notes. The bullet had entered at the back of the neck, 2½ inches to the left of the spine of the seventh cervical vertebra, and had been removed from the right submaxillary region prior to his admission.

He had symptoms suggestive of pharyngeal injury, and this, taken together with the appearance of the gas bubble as seen in the radiograph, caused a tentative diagnosis of an air bubble to be made.

On operation this proved to be correct; the cavity was found to communicate with the pharynx through a wound in its wall, and, as further proof, a bacteriological examination of the contents of the cavity disclosed the presence of yeasts, streptococci, and a large coccus which appeared to be of mouth origin.

CASE 9.—Radiographed on the sixth day and evidence of gas bubbles in the leg obtained.

Clinical notes. The leg was not swollen; there was no emphysema and nothing to indicate the presence of gas, which was not suspected.

Surgical notes. Operation was undertaken purely on the strength of the radiographic report and disclosed gas between the gastrocnemius and the soleus. There were small areas of black muscle digestion but no smell.

Bacteriological notes. Infection was by perfringens and streptococci.

No useful purpose is to be served by mere multiplication of cases narrated. The foregoing have been selected as being representative and the remainder merely resemble one or other of them.

One suggestive fact was noticed throughout the whole series, viz., that in each case characterized by the presence of much gas bacillus perfringens was found on bacteriological examination. From this there appears to be reasonable grounds to believe that the presence of this particular anærobe may be

diagnosed radiographically, though the absence of radiographic signs cannot be taken to imply the absence of the bacillus.

NOTE.—Four cases illustrating gas within the tissues are recorded in the ARCHIVES for December, 1915, by Dr. Woodburn Morrison. When the above paper was written I had not seen them, but they have since been brought to my notice. It is interesting to observe that we have both adopted the same division into localised and diffused.

SARCOMA AND ROENTGEN RAYS.

By G. F. GAARENSTROOM, Chief Assistant, Radiation Department, Dutch Cancer Institute, Antoni van Leeuwenhoekhuis, Amsterdam.

THE number of sarcomas and closely related diseases which were treated by us at the University Hospital at Amsterdam during the last two years (1914 and 1915) amounts to 23. As to the seats of the disease, we may divide these as follows :

Two melanosarcomas of the skin (cheek and foot),
Five sarcomas originating from the bone (femur, fibula, upper jaw, spine),
Six sarcomas originating from the lymphatic tissue (pharyngo-nasal cavity, tonsils, glands of the neck, mediastinum),
One sarcoma (pigmented) of the eye,
One sarcoma of the dura mater,
One sarcoma of the testicle,
One sarcoma of the posterior abdominal wall,
One sarcoma of the cavum tympani,
Three cases of lympho-granuloma,
Two cases of psuedo-leukæmia.

The whole of the patients, whom we treated, had been transferred to us by different surgical sections, as, according to the opinion of the attending surgeons, none of them could be cured by operation, the disease being either in a too far advanced state or because relapses had occurred after operation. That, notwithstanding this, we decided to subject some of these patients to a renewed operation, was solely due to the fact that we hoped to obtain a cure by operation combined with Roentgen rays. We accordingly operated on three sarcomas several times in comparatively rapid succession, and during the intervals the operation wound was vigorously treated with Roentgen rays. In some cases, where we tried a radical operation, only a portion of the tumour could be removed. Another patient, suffering from sarcoma of the knee, was first subjected to radiation, as in this way we hoped to prevent amputation of the leg, but as our efforts proved of no avail we had to amputate the limb. Amongst our 23 patients 16 already showed metastasis in the lymphatic glands. Their age varied between 2 and 72 years.

We made but little use of chemicals during the treatment. In one

instance we administered injections of choline with subsequent radiation, however without any noticeable improvement. In another case we gave arsenic drops, likewise without result, whereas in a further case we applied chloretic zinc to the open wound.

Referring to the technical part of our treatment, we may say that the radiations were all effected in conformity with the rules of the modern deep therapy. We made use of hard tubes and aluminium filters, also when radiating open wounds after the operation. When applying X rays to parts underneath the sound skin, we at first used the customary aluminium filter of 3mm. thickness, with a piece of leather of equal thickness, so as to cut out the secondary radiation of the metal. This protection however proved to be insufficient ; we observed very disagreeable burns of the exposed skin by doses of 15-18 Holzknecht units. We then decided to use 5 mm. aluminium with a leather cover of equal thickness, and this proved quite satisfactory, especially in such cases where sarcomas, located in the interior of the body (abdomen and throat), had to be attacked with big doses. We found that when using a 5 mm. filter we could with impunity use up to 20 H. (1) when applying the rays, and all we noticed was a slight erythema, and loss of the little hairs of the skin, with subsequent peeling and slight pigmentation of the skin. We gave a somewhat smaller dose to women than to men, and with children we reduced the dose to about three quarters. The radiation of the open wound was done as soon as possible after the operation had taken place, and repeated the next day until the required dose was reached. At first when radiating the open wound we used a filter of but 1 mm. thickness, so as to also have the benefit of the weak rays, but we soon had to change this to 3 and even 5 mm., as we found that fibrine coverings had formed in the open wound, which proved most tenacious and but slowly disappeared again.

We complied with a further important detail of the deep therapy by selecting several small areas of the skin and using them as so many entrances for the bundles of X rays, in such cases where sarcoma, situated deep below the surface of the skin, had to be dealt with. We repeatedly adopted this course, taking care not to use too small areas of the skin, and succeeded in curing sarcoma of the pharyngo-nasal cavity, located behind the soft palate, exclusively by radiating through the face and neck. To effect this we adopted as entrances for the rays altogether ten round sections of the skin on face and throat, each measuring 4-5 cm. in diameter, and located as follows : on the nose, on the antrum Highmori, in front of the ear in the region of the M. masseter, on the eye, submental and retromandibular, in all ten sections. The distance from the different spots on the skin to the cavum pharyngo nasale (measured on the skull) amounts to about 8 cm. on an average. Taking the distance between the focus of the tube and the skin at about 18 cm., the bundle of rays, measuring 4-5 cm. in diameter at the moment it passes through the skin, will have expanded to some 6-7 cm. when

(1) H=unit of dosimeter of Holzknecht.

reaching the cavum pharyngo nasale, which is sufficient to cover the whole of its surface. When using hard rays, we measured that about one-tenth part of the surface dose would reach the place of destination, and when carefully directing the bundles of rays through each of the ten sections of skin prepared for the purpose, the dose arriving at the cavum is just about equal to the biggest admissible surface dose. In this way we managed to insert about 20 H. into the tumour. If necessary, the radiation of the cavum pharyngo nasale may be effected through the open mouth by using a speculum. In some cases, where radiation was effected through the eyes, and the latter were not yet affected by the disease, only a passing conjunctivitis of a slight character was noticeable.

The radiations of the different sections of the skin were done at a quick pace and at short intervals. Two or three radiations, lasting a quarter of an hour each, were administered each day, and in this way we finished all sections in about a fortnight. After this we stopped for about six to eight weeks to watch the result. We found that if after the first series of radiations no favourable reaction had manifested itself, it was of no use to try a second series, whereas if on the contrary the first series of radiations had revealed a slight improvement, the radiation was resumed and the tumour gradually disappeared. We however did not then entirely finish treatment, but we continued administering radiations at gradually increasing intervals as a precaution against possible recurrences, especially the regional glands were thoroughly done. Many a radiotherapist who has neglected this very important feature has had cause for deep regret, and has unexpectedly found himself face to face with a serious relapse or metastasis when making a controlling examination.

The following synopsis may give an idea of the results obtained by us. We have also mentioned the location of the disease and the histological structure. In four cases we have not been able to make a microscopical examination of a section of the tumour.

Location.		Treatment.	Result and Duration of it.	Histological Structure.
Pigmented sarcoma	Skin of the cheek ...	Operation and radiation	W.V.S. (1) two years, seven months	Large round cellular
	Skin of the foot ...	Radiation	Negative	Polymorphous cellular
Bone	Fibula	Operation and radiation	Negative † (2) ...	Polymorphous cellular
	Femur	Operation and radiation	Negative †	Polymorphous cellular
	Superior jaw	Operation and radiation	Negative †	Spindle cellular
	Superior jaw	Operation and radiation	W.V.S., one year, seven months	Spindle cellular
	Spine	Radiation	Local improvement	?

(1) W.V.S. = without visible symptoms. (2) † = died.

(Continued on next page).

	Location.	Treatment.	Result and Duration of it.	Histological Structure.
Lymphatic	Cavum pharyngo-nasale	Radiation	W.V.S., one year, two months	Small round cellular
	Cavum pharyngo-nasale	Radiation	W.V.S., ten months	Small round cellular
	Cavum pharyngo-nasale	Radiation	Local improvement †	Small round cellular
	Tonsil	Radiation	W.V.S., one year, eleven months	Small round cellular
	Lymphatic glands of the neck	Radiation	W.V.S., one year, six months	Small round cellular
	Mediastinum	Operation and radiation	Local improvement †	Small round cellular
	Eye (pigmented)	Operation and radiation	W.V.S., one year	Spindle cellular
	Testicle	Radiation	Local improvement †	?
	Abdominal wall	Radiation	Negative †	?
	Cavum tympani	Radiation	Marked improvement	?
	Dura mater	Operation and radiation	Negative †	Polymorphous cellular
Lymphogranuloma.	Neck	Radiation	Local improvement †	Round polymorphous cellular
	Neck	Radiation	Local improvement †	Round polymorphous cellular
	Breast	Radiation	Local improvement †	Round polymorphous cellular
Pseudoleucæmia	Neck	Radiation	W.V.S., one year, two months	Small round cellular
	Groins	Radiation	W.V.S., two years	Small round cellular

Explanation of the Synopsis.—In the first instance we treated two melanosarcomas of the skin, one of the cheek and one of the foot. Both were operated upon and radiated alternately. The patient mentioned at the top of the table appears to be cured, therefore we put—without visible symptoms (W.V.S.), the time elapsed since the treatment being too short to speak of a complete restoration to health. The second patient was operated upon and radiated repeatedly but will most probably succumb to metastasis ; these are already now visible in the skin of the trunk. The following five instances are all sarcomas originating from the bone. None of these have shown a satisfactory reaction when radiated, in spite of the fact that one of these patients was repeatedly operated upon and the open wound thoroughly treated with rays. The femur sarcoma, notwithstanding thorough radiations were administered, did not indicate the slightest trace of improvement. Sarcoma of the spine promptly disappeared by radiation, but reappeared again and again and was accompanied by extensively spread metastasis. We succeeded in curing one case of sarcoma of spindle-celled structure of the upper jaw, by repeated operation and a series of powerful radiation, but we could not avoid considerable mutilation of the face. The following six sarcomas are all originating from the lymphatic tissue, viz., three of the cavum pharyngo-nasale, one of the tonsils, one of the lymphatic tissue of the neck, and one of the mediastinum, all proved to be easily influenced by Roentgen rays, and yielded the greatest percentage of cures. Four out of six are up till now

without visible symptoms of the disease, and the other two, although both died, showed signs of decided local improvement, the tumours having considerably reduced in size.

The next are a sarcoma of the eye, which after operation and radiation has not shown any visible symptoms during the last year, further a case of metastasis in the abdomen produced by a sarcoma of the testicle. This latter showed favourable reaction after the radiation and almost entirely disappeared; the patient, however, died from metastasis in the marrow of the bone. The following case is a sarcoma of the posterior abdominal wall, which did not show any reaction, but of which we neither knew the structure. Next to this an angio-sarcoma of the cavum tympani, which recurred after the operation. The tumour has become smaller, and the existing pressure on the brain has almost entirely disappeared.

A sarcoma of the dura mater with polymorphous cells did not show any reaction at all. We succeeded in improving locally three lymphogranulomas; the patients, however, all died from extensive metastasis. Two pseudo-leukæmia, with considerable lymphatic swellings in the neck and groins were cured, and have not recurred for a period of two years and one year and two months respectively.

Detailed Description of some Interesting Cases.

1. *Skin sarcoma on the Cheek.*—The patient, aged 33, came to us at the hospital on June 2nd, 1913. It appeared that about two months before a wart-like tumour had developed on the cheek and had been operated upon, but about a month later had reappeared, quite as big as before, with accompanying metastasis of the size of a pigeon's egg at the throat. Cheek and throat were operated upon, and after this we radiated the open wounds with about 8 H. units. Three months later we could trace a recurrence in the throat and on the cheek just below the seat of the original tumour. It was decided to operate again, and afterwards 12 H. were administered. After a month had elapsed we noticed that hard, solid spots had formed in the wound. These were cut out again and we applied then rays to the extent of 8 H. In December, 1913, all seemed to be in order, and after having again been subjected to radiation by way of preventive against possible relapses the patient has been free of any symptoms now for two years and seven months.

2. *Sarcoma of the Upper Jaw.*—Patient is nine years old. In June, 1914, exenteratio orbitæ had been effected for a sarcomatous tumour growing in the socket of the eye. Two months after this a relapse had developed at the lower edge of the socket. An operation was then performed, by which only a portion of the tumour could be removed. In November, 1914, the patient was transferred to the surgical section of the University Hospital. A photogram taken immediately, and another taken four days later, showed very rapid growth of the tumour. On December 1st, 1914, an ample operation was performed, but seven days later a fresh recurrence became noticeable. The bare tissue of the sarcoma was then subjected to a series of powerful radiation (up to 50 H. 3 mm. aluminium and leather) lasting five days. A fortnight later,

being doubtful as to the reaction, we operated again and burned with thermo-cauter and chloretic zinc gauses. The wound necrotized to a considerable depth, and we therefore refrained from further radiation. After the necrotic cake had been cast off, which lasted several months, the wound then showed a perfectly smooth surface, epithelium having formed from skin and mucous membrane. The tumour had completely disappeared and the patient has been without any symptoms now for one year and seven months. An artificial jaw has been provided. It was very difficult to find out exactly what effect the rays had in this instance, but we are inclined to believe that the cure was chiefly due to the series of radiations between the third and fourth operation, especially because in such cases of sarcoma where a relapse becomes manifest shortly after the third operation, a further operation will always prove in vain. This is a fact well known to every surgeon.

3. *Sarcoma of the cavum pharyngo-nasale.*—Patient, 17 years old, visited us on February 27th, 1915. He had a big tumour located in the pharynx, and metastasis at the neck on both sides. Upon examining a specimen cut from the tumour, we found it to be lympho-sarcoma. We administered a series of radiations in conformity with the method above described (altogether 84 H.), and after three weeks the tumour had almost gone. Shortly after this a periostal swelling of the lower jaw set in, with high fever, for which we could find no cause except angina. Also the jugular glands were swollen, which made us dread an acute recurrence. Fortunately this was not so, and the swelling soon got better after the fever had gone. In April we noticed in the pharynx a recurrence of the original tumour, which was promptly radiated (17 H.). In May the swelling disappeared again. The man was then able to breathe freely through the nose, which he had not been able to do for a long time, and is now without any symptoms for the last fourteen months.

4. *Sarcoma of the tonsil.*—Patient is 57 years old, and under our treatment since September, 1914. Three months before this date a lympho-sarcoma of the tonsil, and six weeks later a number of swollen glands in close proximity of the arteries at the neck had been removed by operation. In September a recurrence of the lympho-sarcoma was discovered in the scar of the operation wound at the tonsil, and a new metastatic gland underneath the M. St. Cl. mast. caused severe earache. We did not operate, being afraid of fresh recurrence, but we radiated the gland through the retromandibular region in the direction of the tonsil. After four weeks the swelling had disappeared, also the pains emanating to the ear (dosage 12 H.). By way of precaution we radiated again a few times (dosage 32 H.), and kept the patient under regular control. He has now been free of visible symptoms for one year and eleven months.

When radiating sarcomas it is interesting to notice the different degree of sensibility to Roentgen rays. This fact also explains the diversity of opinions expressed in the literature upon this subject. Béclere considers the difference to be so great that he deems it necessary to lift out a whole category of sarcomas, of which the diagnosis can only be made by means of X rays.

Others consider the original seat of the sarcoma an important factor for the sensibility to radiation, and according to their opinion superficial tumours, or sarcomas of the lymphatic glands, are more influenced by rays than tumours lying deeper below the surface. We think this may partly be explained by the difficulty to insert a sufficient dose of rays into deep sarcomas, but on the whole we do not concord with this view, because sarcomas of the mediastinum can sometimes easily be made to disappear by small doses of rays, whereas some tumours of the skin do not show the least reaction even after severe radiation (for instance, our treated cases of sarcoma of the mediastinum and of the skin of the foot).

It is also often thought that the rapidity of growth of the tumour is an important factor, and according to Kienböck, sarcomas which develop quickly and recur soon after the operation, will mostly show a favourable reaction upon being radiated.

This opinion agrees with the doctrine of Bergonié and Tribondeau, according to which cells will be more easily influenced by rays, the greater their power of reproduction is and the more remote their morphology and function are from the normal tissue. The cases which we have described, however, show that this doctrine is not always reliable, and should not be implicitly followed. The sarcomas of the fibula and femur and the upper jaw all showed very rapid growth, but in spite of this, did not favourably react in the least, whereas the angio-sarcoma of the cavum tympani, which had developed very slowly, showed prompt reaction upon being radiated and soon became smaller.

Some authors are attaching value to the histological structure of the tumour. Most of them, however, have acquired the conviction that neither by means of the clinic factors nor by examination of the histological structure is it possible to determine beforehand whether a tumour will react favourably or not.

When reviewing the cases we have treated as to histologic structure and reaction, we find :

Round cellular sarcomas, 12, all of whom have shown favourable reaction ; part of these are now entirely without visible symptoms, the remaining patients showed local cure or improvement but have died from general metastasis.

Spindle cellular sarcomas, 3, two of them have shown favourable reaction.

Sarcomas with polymorphous cells, 4 ; none of these have shown the least favourable reaction.

It is evident from this that round cellular sarcomas generally react favourably, those who are spindle-celled only in some cases, and the sarcomas with polymorphous cells show no favourable reaction at all.

This, however, is not an absolutely sure maxim, as in the literature upon sarcomas we meet with cases in which also sarcomas with polymorphous cells have favourably reacted. As to melano-sarcomas the opinions differ ; some consider them favourable objects for radiation, others do not. This contradic-

tion very likely must be attributed to the fact that although these sarcomas have one quality in common (pigmentation), they should not all be considered alike, for there are sarcomas with big round cells of alveolary structure, but also such with spindle cells and polymorphous cells, and the cases described by us prove that sarcomas with polymorphous cells react badly (compare our case of the skin of the foot) and those with spindle cells and round cells react better (our cases: eye and skin of the cheek). *Altogether we are of opinion that at present the best criterion for determining the sensibility of sarcomas to radiation is the histological structure of the tumour.*

REPORT OF SOCIETY.

ROYAL SOCIETY OF MEDICINE, MARCH 17, 1916.

DISCUSSION ON EXPERIMENTS AND EXPERIENCES WITH THE COOLIDGE TUBE.

Opened by ROBERT KNOX, M.D.

THE construction of the Coolidge tube is now familiar to all; it is therefore only necessary to describe the uses to which it may be put in radiography, radioscopy, and X-ray therapeutics, and to touch on a few practical points in its manipulation.

Considering firstly the use of the tube in radioscopy, it may be briefly dismissed with the remark that it possesses, amongst other advantages over other tubes, that of extreme adaptability, being readily adjusted to suit the requirements of the case under examination. It can be used continuously for long periods, without fear of damage, with the currents likely to be required for a prolonged screen examination. The experience gained in therapeutic work warrants the statement that a current of 4 ma. to 5 ma. can be continuously passed through the tube for many hours. This quantity of current should be ample for any screening examination. It is well, however, to issue a word of warning on behalf of the patient and of the operator. Both must be efficiently protected, and the radiologist must not forget to cut down the time of examination to the minimum lest in his enthusiasm he may damage his patient or himself.

In radiography the Coolidge tube will be found to possess advantages which at present can hardly be estimated accurately. But as time elapses and the use of the tube becomes more general, radiologists will find that in this tube they possess an instrument of precision far in advance of any previously produced. Its first great advantage is the ease with which it can be adjusted to conditions suitable for radiography of various parts. By regulating the heating current in the accessory circuit the tube can be arranged to give rays of varying penetrative power. Another advantage is its capacity for taking very large discharges from the secondary of the coil or transformer; these may be used for instantaneous exposures, or long exposures with heavy currents may be given.

I consider it the ideal tube for single flash exposures—nearly all the radiographic results shown were obtained with a high-tension transformer—but it is equally adaptable to a large or small coil outfit. In the latter case the inverse current must be as nearly as possible suppressed if the best results are to be obtained. In this respect the single impulse coil with its absence of inverse current will be very useful in work with the Coolidge tube.

In order to show how the Coolidge tube may be manipulated in radiography, I have had a number of experiments carried out, the results of which I shall briefly describe to you. In passing, it may be well to point out that so far these experiments have been elementary in

character, the object being to ascertain the best working conditions of the tube in radiography and radioscopy. From these observations it is possible to indicate the advantages of the new tube—no other tube would have given similar results in the time taken for these experiments. One tube only has been used for all the experiments shown, and it was frequently adjusted from a very soft condition to a moderately hard one in a few seconds. It is hoped that with more exhaustive experiments it may be possible to lay down definite rules for the production of particular results; in other words, it may soon be possible to standardize radiographic exposures, and it is also hoped that some real advance may be made in the vexed question of the measurement of X-ray dosage.

Particulars of Experiments.

The plates which illustrate this part of the paper were all obtained from the dried femur. A penetration gauge was employed, consisting of a strip of aluminium 140 mm. long and 20 mm. wide, divided into seven squares, the first of which is 1 mm. thick, each of the others being twice the thickness of the preceding one, the seventh being made of a heavy metal equivalent to aluminium 64 mm. thick. In each of these squares small circular lead plugs are let in. The gauge when radiographed shows white spots on a dark ground, and the slides taken direct from the radiogram show black dots on a lighter ground. The lead plugs are inserted in numbers, 1 to 6; they have no relation to the thickness of the aluminium steps.

Development of the Plates.

In most of the radiograms shown, the exposures have all been made on one plate, or the plates have been developed all together; special mention is made in those cases where the plates have been developed separately.

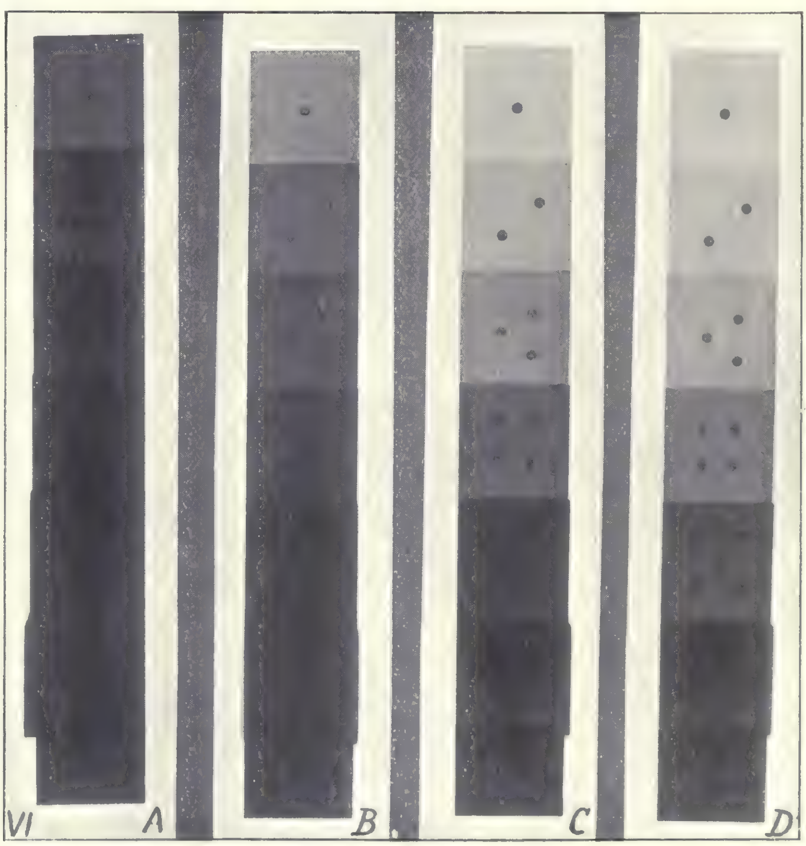


Fig. I (Experiment II).

Experiment I.—Four plates were taken with different heating currents in the filament circuit, the regulator in the primary circuit remaining unaltered. An exposure of 5 sec. was given to each plate. The plates were developed in the same dish, each receiving the same time allowance. With a heating current of 4·42 amp. the tube was so soft that only an outline of the bone was obtained, the penetrometer recording one spot. The other three, with heating currents of 4·3 amp., 4·17 amp., and 4 amp. respectively, all gave good results, though the third and fourth were greatly over-developed. A second batch of four plates taken under the same conditions, but each developed separately, gave a good result in three of the plates, which were taken with heating currents of 4·3 amp., 4·17 amp., and 4 amp. The details of these experiments are as follows:—

	Heating current amperes	Current in primary amperes	Current in secondary milliamperes	Time of exposure in seconds
A ...	4·42 ...	45 ...	30 ...	5
B ...	4·3 ...	39 ...	25 ...	5
C ...	4·17 ...	30 ...	15 ...	5
D ...	4·0 ...	20 ...	5 ...	5

Regulator in primary circuit constant. Time of exposure constant. Heating current varied ; note the influence of heating current upon (*a*) primary current. and (*b*) secondary current through tube, resulting in a drop from 30 ma. to 5 ma. The spark-gap in these experiments was not taken into account. Its importance as an indication of the penetration will be shown later.

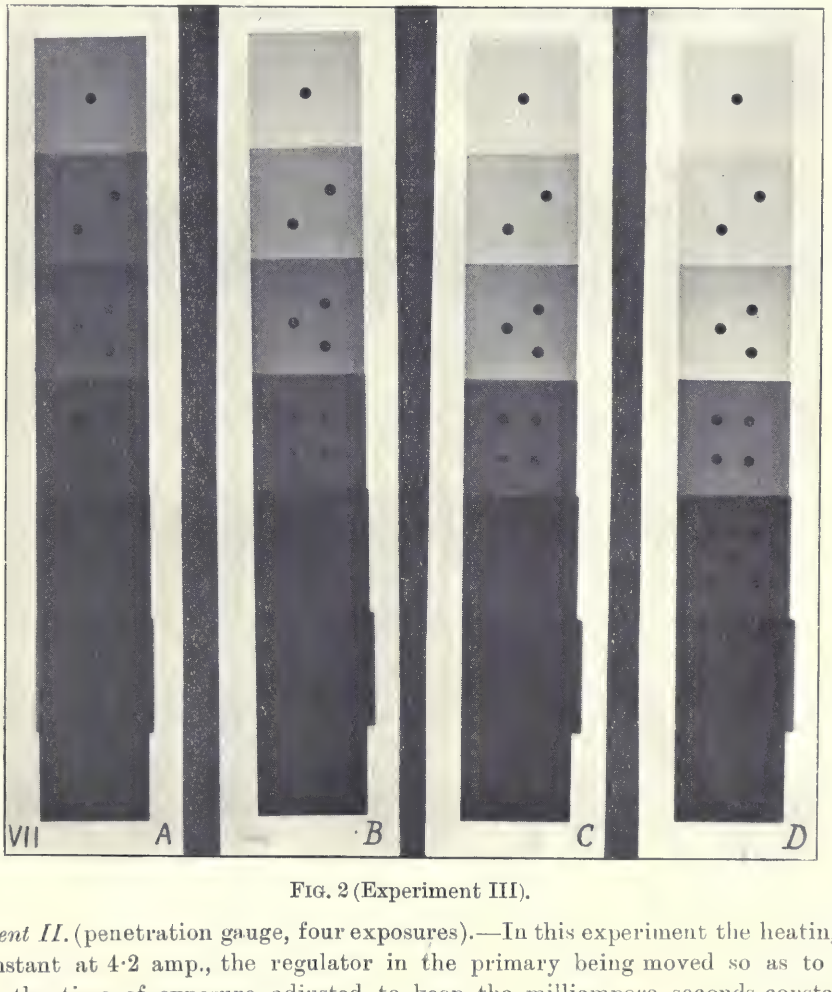


FIG. 2 (Experiment III).

Experiment II. (penetration gauge, four exposures).—In this experiment the heating current was kept constant at 4·2 amp., the regulator in the primary being moved so as to vary the current, and the time of exposure adjusted to keep the milliampere seconds constant. The slide shows the great increase of penetration with the harder rays.

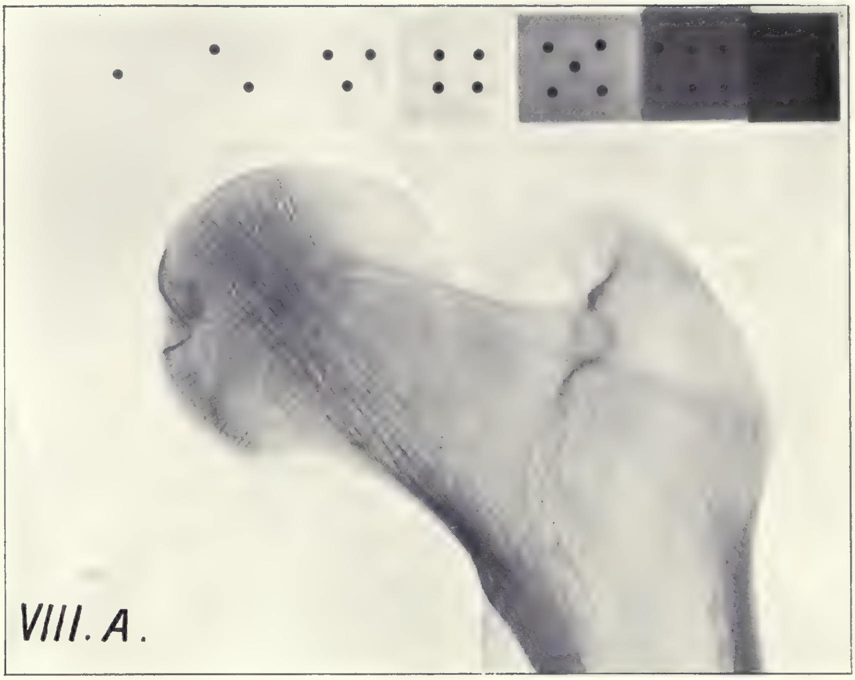


Fig. 4 (Experiment V).

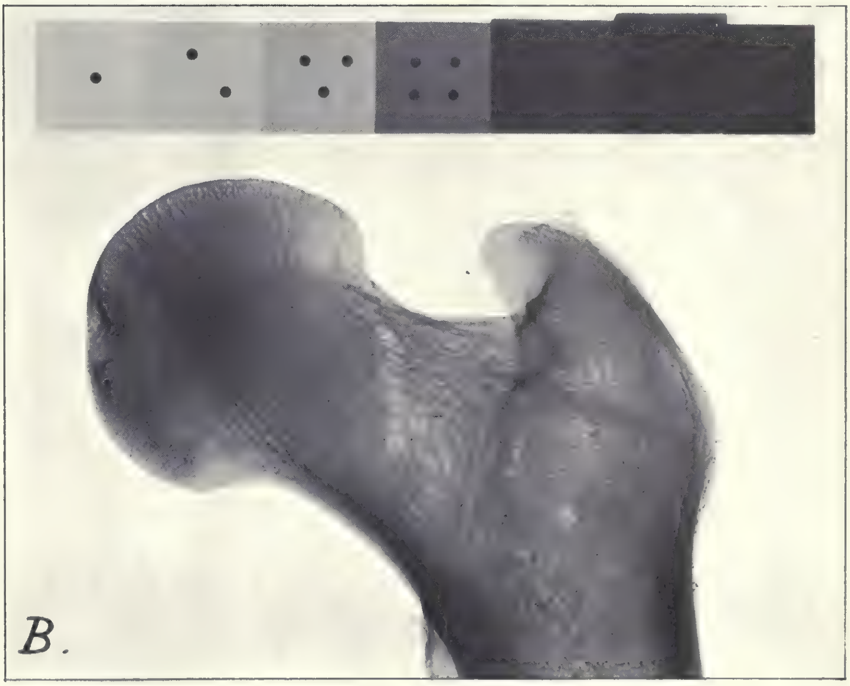


Fig. 5 (Experiment V).

Fig. 6 (Experiment V).

Fig. 7 (Experiment ueberpruefung V).

	Heating current amperes	Current in primary amperes	Current in secondary milliamperes	Exposure seconds	Milliampere seconds	Approximate spark-gap between points
A	4·2	25	12	30	360	1 in.
B	4·2	27	14	26	364	1½ ,,
C	4·2	30	17	21	357	2¼ ,,
D	4·2	32	20	18	360	3¾ ,,

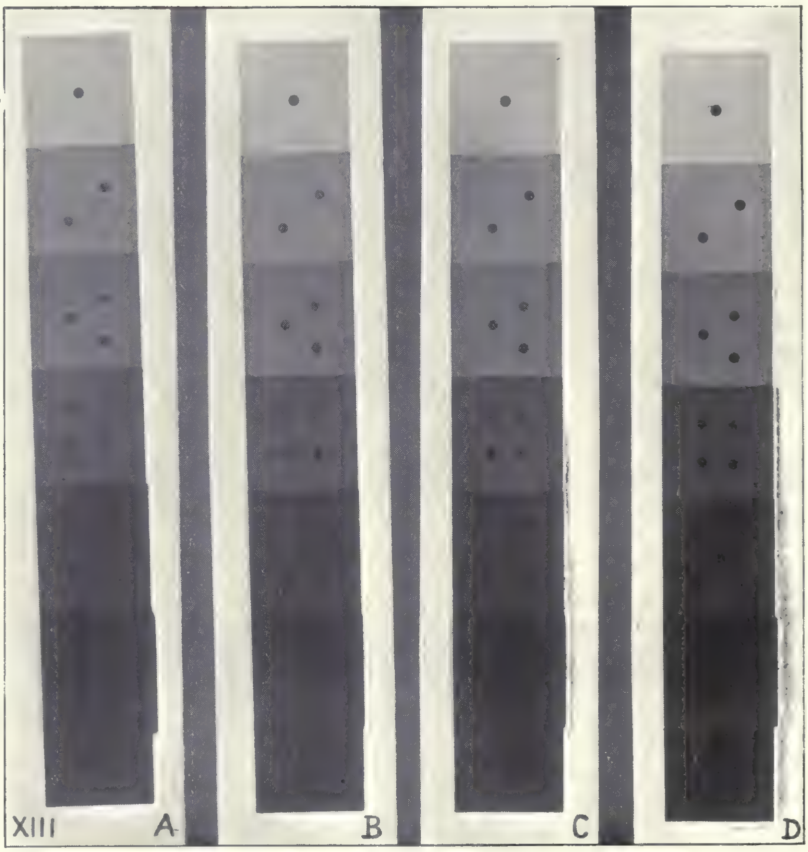


Fig. 3 (Experiment IV).

Experiment III.—The next experiment was carried out to show the effect of variations in the time of exposure. The heating current was 4·2 amp., the milliamperes 24, and the approximate spark-gap 2½ in. The exposures given were 3 sec., 6 sec., 12 sec., and 24 sec. respectively. This resolved itself into an attempt to find the best exposure time under the existing conditions and need not be further discussed. It might be noted that eight times the length of exposure in *D* gives practically the same result as when 3 sec. is given in *A*. On the lower registers the penetration is greater with the longer exposure.

Experiment IV.—This was carried out with the object of ascertaining the effect of varying the distance of the plate from the anticathode; the exposures given were approximately proportional to the square of the distance, and the resulting negatives were practically all similar. The details of the experiment are given as follows:—

	Heating current amperes	Amperes	Milliamperes	Seconds	Milliampere seconds	Spark-gap
A	4·2	23	12	30	360	1 in.
B	4·2	27	14	26	364	1½ ,,
C	4·2	30	17	21	357	2¼ ,,
D	4·2	32	20	18	360	3¾ ,,

Experiment V. (head of femur and penetration gauge).—In this experiment the heating current was varied and the regulator adjusted to get the same spark-gap in each case, the exposure time being arranged to keep the milliampere seconds constant. The negatives are not identically * the same. The following table gives the full particulars of this experiment:—

* This has also been pointed out by Mr. Schall in a paper recently read before the Röntgen Society.

Heating current amperes		Current in secondary milliamperes		Exposure seconds		Milliampere seconds		Spark-gap
4·3	...	36	...	3·0	...	108	...	3⅛ in.
4·2	...	25	...	4·4	...	110	...	3⅛ ,,
4·1	...	20	...	5·5	...	110	...	3⅛ ,,
4·0	...	12	...	9·0	...	108	...	3⅛ ,,

(To be continued).

NOTES AND ABSTRACTS.

ELECTRO-THERAPY.

The Restoration of Nerve Function as a Result of Electrical Treatment after Suture of a Sectioned Nerve.—Mendelssohn (*C. R. de la Société de Neurologie de Paris*, December 2nd, 1915, and story of case continued *Arch. d'élec. méd.*, June, 1916).—This was a case in which the radial nerve had been sectioned by a projectile. The man was wounded in the left arm by a piece of shell, and had all the symptoms of complete radial paralysis. On examination the nerve was found to be incompletely sectioned, the part not sectioned being transformed into ecchymotic pulp. This part was resected, and the two ends cleared and sutured. A month after suture, when the patient left the care of the surgeon, there was no sign of a return of motility. The case was then sent for electrical treatment. There was at this time in evidence the complete syndrome of paralysis of the left radial nerve, the hand swinging and drooping, the extension of the fingers of the hand on the forearm impossible, and lateral movements of the hand equally impossible, in fact the paralysis of all the muscles innerved by the radial, with abolition of the tricipital and other reflexes. As to the troubles of sensibility, there was a small degree of hypoæsthesia on the back of the hand and the posterior surface of the forearm. The electrical reaction in the case of both currents was abolished in the radial nerve examined at the level of the upper arm; some muscles in the territory of this nerve presented complete R.D., with polar inversion and extremely slow contraction. The patient was subjected to electrical treatment in the shape of faradization of the nerve, which did not react at first, and systematic galvanization of the paralyzed muscles, the anode first being closed, and then the cathode. For at least four weeks the treatment gave no favourable result, the hand remaining always drooping and hypotonic; but from the beginning of the second month, the first signs of the return of voluntary motility were manifested, and the amelioration increased rapidly and progressively, being almost complete 200 days after suture. All the paralysed muscles then contracted more or less under the influence of the will; the extension of the hand on the forearm was easy; that of the fingers was possible, though still limited; the lateral movements of the hand were executed with ease, those of supination were more difficult. The troubles of sensibility had completely disappeared save for a certain increased sensitiveness to pain in the cutaneous zone of the radial. The electrical reaction was still not normal. The muscles which had been attacked began by reacting first to faradic current, and gradually galvanic contraction became less and less slow. The case thus bore out Duchenne's formula that, in the wounded peripheral nerves, the return of voluntary contractility preceded that of electrical excitation. In this patient also the return of faradic excitability to the nerve

preceded considerably the return of faradic excitability to the muscle. The cure has since become complete, and the patient returned to the Front in March of the present year, ten months after the injury. The author attaches much importance to following up the operation of nerve suture with a methodical and regular electrical treatment. H. C.

RADIOLOGY.

A Roentgenological Study of the Gastro-intestinal Tract in Diabetes. A Report of 72 Cases.—James T. Case (*Jour. Am. Med. Assoc.*, XLVII., No. 12, September 16, 1916, p. 858). —In summarizing the statistics and general results of 72 cases of diabetes recently examined roentgenologically at the Battle Creek Sanitarium, Case states that in spite of the necessity of careful attention to intestinal hygiene as part of the treatment, the literature contains very few articles dealing with intestinal stasis as a cause of diabetes. He mentions Brosch, A. C. Jordan, N. Mutch, Croftan.

The Roentgen studies in the 72 cases were carried out according to the routine established by the author in the Roentgen Department of the Battle Creek Sanitarium, full details of which he communicates, including the necessary preliminaries.

Gallstones were definitely visualised in six of the cases (8 per cent.), while in eight others suspicious shadows proved to be gallstones at operation—another example in support of Case's contention that suspicious shadows should be reported. In view of the close relationship between gallbladder and pancreatic affections, the significance of this high percentage of gallstones in diabetes is obvious.

In a large number of the cases a transverse stomach was found, probably due to adhesions, notably hepatofixation, and also to the fact that obesity is a frequent condition among diabetics.

In two cases there was carcinoma of the stomach, and in two carcinoma of the pancreas.

The emptying time of the stomach was unusually rapid, being from four to seven hours and a half. These findings agree very well with clinical experience, it having been shown that aspiration of test meals in diabetes must be made within twenty or thirty minutes to be effective. Duodenal stasis was observed in only one instance, and Case believes that the difference in the definition of duodenal stasis may account for the difference between his and more frequent findings reported by other authors. The duodenal shadow has failed to impress him that there is a characteristic change in the dimensions of this bowel in diabetics as compared with normal individuals. The ampulla of Vater was not visualized in a single instance, while 25 or more of the cases in which a dilated ampulla was observed were non-diabetic. This result was rather unexpected on the assumption that duodenal stasis is common in diabetes.

Ileac stasis was present in the severe cases, this being a characteristic sign, and it would probably be more apparent in mild cases, too, if the author's conservative definition of ileac stasis were less strictly applied. Incompetency of the ileocæcal valve was shown in 13 of the 20 worst cases, and in 10 of the 20 mildest. It was found competent in the remainder of both categories. The degree of incompetency cannot as yet be satisfactorily determined. No constant relation could be established between the severity of the diabetes or the degree of ileac stasis and the presence or absence of adhesions of the terminal ileum, nor the severity of appendical involvement.

Spasticity of the distal colon existed in 46, of the proximal in 14 cases.

The average emptying time of the colon was 48 hours in the 20 worst, and 36 hours in the 20 mildest cases, the normal time under the circumstances of the tests being about 36 hours. J. T. C.

Clinical Radiology of the Œsophagus.—Luigi Parola (*La Radiologia Medica*, May-June, 1916, p. 113-140). — Dr. Parola contributes a very elaborate study on this subject, compiled from the publications of over one hundred authors as well as from his own experiences.

He considers that the best position for examination is Holzknecht's first oblique position, whereby the œsophageal shadows are seen between those of the heart and the spinal column. As a means of examination opaque capsules and pills are very dangerous, and the opaque tube is not without objection. The

use of a 10 mm. rubber tube containing bismuth subnitrate has, however, been of great service in determining the anatomical relationships of the normal œsophagus.

Since 1880 the physiology of deglutition has been explained mainly by the "three phase" theory of Magendie, but recently Schreiber has declared that the act is not performed by a single process of pressure but by a series of individual actions which in their sequence and time relationship bear an analogy to the action of the heart. F. Kraus has used a cinematographic method of radiography, and concludes, somewhat differently, that the œsophagus is first filled by the action of the mylo-hyoid and hyo-glossus before there is any muscular contraction in the pharynx and œsophagus, and that the true œsophageal phase then begins and is of peristaltic nature. The author's final decision seems to be in accord with the ordinary physiological teaching. He next deals seriatim with the various affections of the œsophagus.

Cases of sepsis and inflammation should be examined in order to settle the differential diagnosis.

He has long noticed that in a chronic simple œsophagitis—*e.g.*, alcoholic—the bismuth meal passes slowly down the whole length of the œsophagus and leaves streaks of bismuth which are visible for a long time afterwards. Congenital strictures are not of great interest except for differential diagnosis.

In the examination for foreign bodies X rays are much better than the sound, which is both fallible and dangerous. The œsophagoscope is probably necessary only in cases where the foreign body is not opaque, but it is well to make sure by using both methods. The finding of the shadow by X rays is of less importance than its interpretation in the light of much experience.

In all stages of stenosis the main sign is the obstruction—of greater or lesser degree—to the passage of food. The important appearance, seen by carefully watching the whole process of the passage of the meal, is the dilatation at each part, as the food passes, except at the stricture. A barium meal is better than bismuth for this purpose. Another appearance is that of the rising and falling of the mass in the part above the stricture. This is due to waves of peristalsis and anti-peristalsis, and is essentially due to the stenosis and not to mere obstruction. It is found in all stenosis and does not of itself suffice to exclude the spasmodic form.

In the case of malignant tumours the radiologist should not make his examination until he knows all the clinical details of the case, as his work and findings must be based upon this knowledge. All he can show is stenosis, and the difficulty is to say to which class it belongs. The several differential radiological signs which have been suggested are not reliable, and X rays cannot alone establish the diagnosis. Metastatic affection of the mediastinal glands is a useful clue, and the dilatation above the tumour is less noticeable than in benign stenosis. This is due partly to the infiltration and loss of elasticity, and partly to the fact that constant vomiting prevents the accumulation of much food in this part of the œsophagus. The author does not fully agree with Eisenstein when he says that the outline of the mass of bismuth above a stenosis is always smooth in cicatricial cases and rough in constriction due to carcinoma.

The rule that a mediastinal tumour which shows a shadow is extra-œsophageal and not in the wall of the organ has only very rare exceptions.

The advent of X rays has thrown new light on the nature of neuropathic conditions. Œsophagismus and pharyngismus are real motor disturbances and not merely due to subjective hyperæsthesia; while idiopathic dilatation is more common than formerly believed. The diagnosis between this and the dilatation above a stenosis is not always easy but the presence of peristalsis is in favour of the latter.

Diverticuli are discussed in great detail. Their examination requires great care on the part of the radiologist, and repeated observations.

Deviation and compression are easy to observe and are mainly due to aneurism. This should, therefore, be the first thought of the radiologist when examining a case of slight dysphagia, and he should avoid the use of the sound until radioscopy has proved that it is permissible.

N. B.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

TWO CASES OF INTEREST.

By S. Gilbert Scott, M.R.C.S., L.R.C.P.

Radiologist to the London Hospital.

CASE 1. AIR AND FLUID IN THE LEFT CRANIUM.

A female, aged 38, was sent to me for a radiographic examination of the skull, to see if any abnormality could be detected. On asking her what she chiefly complained of, she answered, "Very severe headaches, and I feel my brain 'splashing!'" At first I ignored this symptom of "brain-splashing" as a subjective sensation, it being the patient's way of describing some

peculiar feeling in her head. However, on further cross-examination, I elicited the fact that she not only felt the "splashing," but that it could even be heard by those around, when, for instance, she suddenly lifted her head after bending down to put on her boots. This fact increased my interest in the symptom, and being anxious to hear for myself, if possible, this "splashing," I asked her to endeavour to reproduce it. This she proceeded to do, and I certainly was conscious of some peculiar sound. My curiosity by this time being thoroughly roused, I took hold of her head in both hands and shook it vigorously. The sensation imparted to my hands, together with the sound produced by this procedure was most extraordinary, not to say alarming, and

Case 1.

one instinctively let go the head. Free fluid in considerable quantity could be felt moving about in the cranium, coming up with a resounding "smack" against the frontal bone. The "smack" or "splash" could be distinctly heard several feet away. As mentioned before, the sensation was most alarming, suggested shaking a cocoanut partly filled with fluid. As these signs indicated the presence of air and fluid in the cranium, I expected to find interesting radiographic appearances. In this I was not disappointed. The findings are here reproduced.

The plate, taken with the patient in the upright position, shows the horizontal line of the fluid in the frontal region. In the antero-posterior view this was seen to be limited to the left side. Above the line of fluid the air space can be seen. The frontal lobe appears to be displaced backwards by the air and fluid. A dense bony tumour is also seen growing from the left orbital plate (exostosis). The "screen" examination showed the fluid level remaining horizontal in all positions of the head. Shaking of the head produced movements of the fluid similar to those seen in a pyopneumothorax. The manner in which the fluid moved, together with its density, suggested it being of a serous nature rather than a purulent. *The past history of the case* is as follows :—Nine years ago a bony tumour appeared to the inner and upper part of the left orbit. An ophthalmic surgeon refused to touch it. She was then sent to a general surgeon, who removed the tumour with apparent success. She remained quite well, except for occasional headaches, until eight months ago, when these became much more frequent and severe in character, usually coming on during the afternoon, till they became unbearable. The "splashing" was first noticed five months ago. Her mental condition has remained quite normal, and was so when I saw her in June, 1915. Her headaches then were so terrible that she was quite desperate. She was subsequently operated upon, the frontal bone being trephined. The findings, however, did not throw much light on the condition. I have been unsuccessful in tracing the patient, she having changed her address since leaving the hospital.

It is difficult to account satisfactorily for the condition. How did the air get into the cranium? Was the fluid normal cerebro-spinal in excess?

My theory is, that when the bony tumour was removed from the orbit, nine years ago, a small opening was made through the roof into the cranium, and that air has been admitted in small quantities since ; being unable to escape, has gradually reached its present proportions, and is only now giving rise to symptoms. As the anterior part of the left brain is being displaced backwards, considerable tension on the nerves at the base of the brain is being produced, probably accounting for her severe headaches. There is an excess of normal cerebro-spinal fluid.

CASE 2. CHARCOT'S JOINT ASSOCIATED WITH MYOSITIS OSSIFICANS.

A female, aged 42. The radiograph shows a typical Charcot's joint of the left hip with complete destruction of the head and neck of the femur, with upward displacement of the shaft. In spite of this condition the patient was able to walk fairly well. Large bony deposits are also seen in the muscles to the inner side of the thigh, the condition being that of myositis ossificans. This formed a definite tumour, which could be distinctly seen, to

the inner side of the thigh. On palpation this felt as if there were pieces of stick embedded in the muscles, freely movable in every direction. *The history* is short. She was quite well until two months ago, when she first noticed a tumour in the inner side of the left thigh. For one month she thought there was something wrong with the hip, and experienced slight difficulty in walking.

The interest of the case lies in the combination of a Charcot's joint and myositis ossificans, both appearing about the same time, and the question as to

Case 2.

whether there is any relation between the two. Charcot's joints are themselves of considerable interest, especially when the condition is seen radiographically. The extensive destruction of the bone, usually only involving a single bone of the joint and its articular surface. The small amount of disability and pain produced by the condition is remarkable. Isolated bony deposits are usually seen around and outside the joint.

What pathological process accounts for this extensive destruction and the deposit of bone where no bone elements are normally present?

THE POWER OF ELECTROLYSIS TO CURE SUPPURATION.

By Charles Russ, M.B. (Lond.), M.R.C.S.
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Experimental work of the last few years has shown that in electrolysis we have a force of great value when applied to suppurative lesions, but so far its use has only been developed on a small and comparatively restricted field.

It is known that nearly all the common pyogenic bacteria move to the positive electrode in a common salt solution traversed by the constant current. Further, it is known that there is a strong germicidal effect manifest at the positive electrode after a short flow of the current, and this lethal effect is present (though weaker) at the negative electrode.

Now both of these effects can be brought into play for the relief of suppuration in connection with human diseases.

The necessary conditions are as follows :—

Supposing we have an open suppurating surface (ulcer), irregular wound, or a sinus discharging pus, the first step is to submerge the lesion in sodium chloride solution, 1 or 2 per cent. This has been done (in the case of ulcers of the leg) by fixing a glass cylinder (made fluid-tight to the healthy skin by plasticine) over the ulcer, and the sodium chloride solution was poured in to a depth of one or two inches. A carbon or platinum foil electrode was just

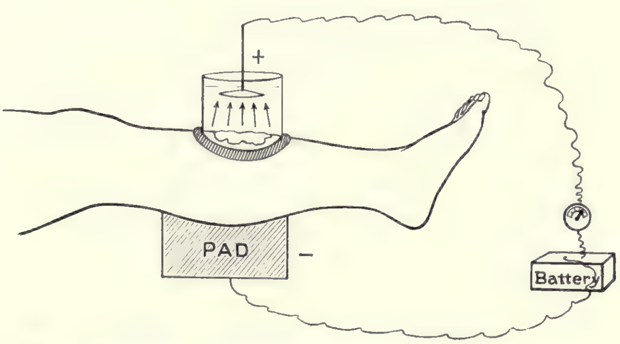


Fig. 1.—Diagram to show scheme of Electrolysis of ulcer of the leg.

submerged in the sodium chloride and under the limb a saline soaked pad of comparatively large size was also arranged. (Fig. 1.) Now, if the pad is made the negative, and the disc over the ulcer the positive electrode, and a constant current of a few milliamperes be passed, the following forces are brought into play.

The chlorine atoms become linked to the bacteria in the granulations, and in moving to the positive electrode they escort the organisms out of the ulcer. Simultaneously there is a strong germicidal effect proceeding within the contents of the glass cylinder.

With regard to bacteria which are not on the surface of the granulations, and which are described as within the tissues, a few remarks may be added. We have, of course, no exact knowledge of the presence of living bacteria within the living protoplasm of fixed tissue cells, except for the familiar picture of organisms apparently within the polynuclear leucocyte (phagocytosis). Since the latter always deal successfully with their victims, visibly in the phagocytosis shown in pus microscopy, we need not doubt the bacterial exit from the body by this agency. However, as to the bacteria in the cell spaces of granulations and the lymphatic channels of septic wounds, there is good reason to believe in the directing power of electrolysis. For the salts of lymph and wound exudates are mainly halogen compounds of the alkali metals and earths, and during electrolysis of such salts the same affinities for the bacteria within such districts are doubtless at work, and the lymph and exudate streams can provide the fluid path up to the saline column we apply to the lesion.

A short digression will further illustrate this important point. It is now a matter of daily experience that leucocytes from an infected mucous membrane proceed in normal saline to the anode. This is very forcibly presented in the harvest of morbid matter visibly involved in the perforations of the catheter after electrolysis of the urethra in gonorrhœa. I have frequently microscoped such masses of yellow muco-pus and find the composition to be of polynuclear leucocytes incorporating numbers of the bacteria.

Since this mucous membrane had been washed by a preliminary urination, it is manifest that this tide of pus cells and bacteria has been set up and withdrawn by the process, and that its component elements have emerged from the crypts and mucous ducts of the lining membrane. It is also a significant fact that day by day this harvest diminishes until the stage of no spontaneous discharge is reached. After further electrolysis to remove threads, one finds no visible harvest withdrawable.

To return however to our simple case of the ulcer, we find a third beneficial effect is set up in the lesion, and is visible to the naked eye after the current has passed a few minutes. A previously anæmic ulcer will become coloured by an augmented blood flow. The ulcer now looks blood red, and if the current be strong enough obvious hæmorrhage will take place. By the increased blood flow induced in this way we have all the benefits of the Bier's bandage. The antibodies are brought into play and the removal of other substances by the blood and lymph vessels is amplified.

From the foregoing it is clear that in electrolysis we have an important agency which can be applied to all suppurating areas, provided they are such as permit the superposition of a column of fluid through which the current can flow.

It is certain that many of the septic wounds of this war, or those following surgical incisions, can be healed in this way with no pain and unaccompanied by any irritation of antiseptic solutions.

There is another aspect of the system, however, which I think needs notice. In order to obtain the optimum effects as quickly as possible it is necessary to consider the chemical happenings at the negative electrode.

In ionic medication the object seems to be to drive metallic elements into the granulations, doubtless with a germicidal intent, and sometimes zinc or copper is used.

Now in the cases I have treated by electrolysis the aim is the provision of a liquid highway (NaCl) for the all-important bacterial emigration from the wound.

Although the chlorine atoms are carrying the organisms and pus cells out of the body in this way, it is manifest that sodium atoms are entering the tissues. The amount of sodium entering will depend on the current's magnitude and the time it is passing. Clinically, I find this must not be excessive or two bad effects are shown.

Firstly, the alkalinity set up is painful, and secondly, if too much sodium enters the tissues there is retardation of the healing—doubtless a toxic effect of sodium upon the cell protoplasm.

The ideal to be aimed at is to keep the reaction at the body-surface neutral, or only slightly alkaline. With this end in view one naturally thinks of the use of a double electrolyte.

Such a compound solution is illustrated by sodium chloride and iodic or chloric acids.

$$\left.\begin{matrix} NaCl \\ HClO_3 \end{matrix}\right\} \text{ or } \begin{matrix} NaCl \\ HIO_3 \end{matrix} = \begin{matrix} NaI + H \text{ and } ClO_3 \\ \text{or } NaCl + H \text{ and } ClO_3 \end{matrix}$$

It is clear that these substances are decomposed during electrolysis, as shown above, and we have the alkalinity of the sodium neutralized by the simultaneous liberation of HCl. The benefit, however, has to be discounted by the fact that although sodium chloride is borne by even a raw surface in a strength of 2 per cent., chloric acid smarts even in a strength of 1-200. Therefore the attempted neutralization of the sodium can only be partially effected. Reversal of the current is, I think, quite useful, but I have obtained still better results as follows. I have done fairly numerous electrolyses of cultures of common bacteria, in which I used sodium chloride solution and various organic acids of rather low conductivity. I observed the degree of alkalinity at the cathode every five minutes by transferring some of the fluid from the cathode to litmus paper.

Certain low conductivity organic acids, if mixed with sodium chloride, are comparatively little decomposed, and if only a small current flows, the acid (as such) is free to neutralize the alkalinity of the sodium atoms as they arrive at the cathode.

After using such a fluid I have found better clinical results in dealing with suppuration of the urethral mucosa, and such a mixture is an improvement

upon plain sodium chloride when treating any suppurating lesion by electrolysis, and after further tests I shall publish its composition. By further clinical work we shall no doubt acquire still better mixtures, for I believe the difficulty is only one of selecting a second electrolyte to neutralize the sodium liberation, and the strength of the second electrolyte is dominated by its tolerability by inflamed membranes, or suppurating wounds.

The forces at our disposal on the lines of electrolysis are, I believe, of great importance and utility, and the clinical results so far obtained justify a much more extended use. It remains for each operator to adapt suitable apparatus to the particular lesion he wishes to heal, and to use a solution for the electrolyte which approximates to the physiological fluids of blood or lymph, *e.g.*, NaCl, say 1 per cent., with weak iodic or chloric acid.

In between electrolysis treatments, a compress or plug impregnated only with the same fluid will be found an excellent dressing. In this way one avoids the irritation and toxic effects unavoidable with ordinary antiseptics, whilst on the other hand one is able to relieve the infected area, at each electrolysis, of large bacterial populations by means of nothing more potent than saline and a few milliamperes of the constant current.

In using this system in the last four years I have followed a few simple rules which may also be mentioned.

Never allow the process to be painfnl. Either cut down the milliamperage or reduce the alkalinity by a short reversal, or pouring in more electrolyte (diluting the alkalinity).

Further, do not overtreat the case. This is one of the commonest mistakes I find in urethral work. When the diminished purulent exudate shows the body powers to be in the ascendant, the discretion of experience will often withhold further interference, and healing, with no relapse, will follow.

A further point on which I often find an error made is to continue irrigation or other germicidal applications between electric treatments. Such procedure nearly always spoils or delays progress. Let us have the system and nothing but the system (medicines by the mouth can of course be employed as their influence is small), and if well carried out there need be no apology for the results.

THE X-RAY SPECTRUM OF TUNGSTEN.

By A. W. Hull.

Research Laboratory, General Electric Company.

Reprinted, with permission, from the "General Electric Review," Vol. XIX, No. 7, July 1916.

The Nature of X rays.—Ever since the discovery of X rays, in 1896, scholars have been divided in opinion regarding their nature. One school, led by Prof. W. H. Bragg, held that the rays consisted of high speed particles, so small and so fast that they could penetrate solid bodies. Their arguments were based mainly on the energy changes between the X rays and the cathode rays that produce them. The other school considered the X rays to be the same in nature as ordinary light, *i.e.*, electro-magnetic waves, and the principal evidence in favour of this view was the fact that X rays cannot be bent or deflected by the strongest electric and magnetic fields. The question has now been settled in favour of the wave theory, and it is a beautiful example of scientific open-mindedness that Prof. Bragg, the champion of the corpuscular theory, was one of the first to accept the decisive evidence, and has become the chief exponent of the wave theory which he so long opposed. It is interesting to note that exactly the same difference of opinion existed in Sir Isaac Newton's time regarding the nature of ordinary light, and that Newton, during his whole life, believed in the corpuscular theory. We may be sure that he, too, would have been prompt to change to the now-accepted wave theory, if the decisive evidence had appeared in his life-time.

It is not the purpose of the present article to describe the beautiful experiments which led to the solution of this problem—this has been ably done by Prof. Bragg himself (1)—but rather to present as vivid a picture as possible of the present theory and its interesting consequences.

Definition of Spectrum.—Since light consists of waves of electric and magnetic force travelling through space, its quality must depend on the lengths of these waves, and, if there is more than one wave-length, on their relative intensities. The spectrum of the light is the sum total of these wave-lengths, weighted according to their intensities. The commonest form of spectrum is a photograph of the beam after it has passed through a prism or grating. The prism or grating separates the wave-lengths and sends each to a different point on the photographic plate, where it produces a blackening proportional to its intensity. The distance measured horizontally along the spectrum

[1] **"X rays and Crystal Structure" by W. H. and W. L. Bragg, G. Bell & Sons, London, 1915.**

(*cf.* Fig. 3) gives, therefore, the wave-length, and the blackness at that point the intensity, of each constituent of the beam. If the intensity of any particular wave-length is greater than that of its neighbours it stands out as a black line, thus producing the so-called "line spectrum" that is characteristic of gases and vapours. Fig. 3 is an example. The black lines print as white lines.

In the light from an incandescent solid body, on the other hand, the intensity of neighbouring wave-lengths differs but little, so that its spectrum is a continuous band, shading off gradually on each end. In this case the photograph is less satisfactory for expressing the intensity relation than a curve like Fig. 4, which represents the spectrum of incandescent tungsten at 2200° C. Here the distances measured horizontally represent wave-lengths, the same as in the photograph, but the intensity of each wave-length is represented by the vertical height of the corresponding point on the curve, instead of by the blackness.

The Mechanism of Radiation and Reflection.—A ray of light consists of trains of waves sent out by the vibrating electrons in the luminous body, one

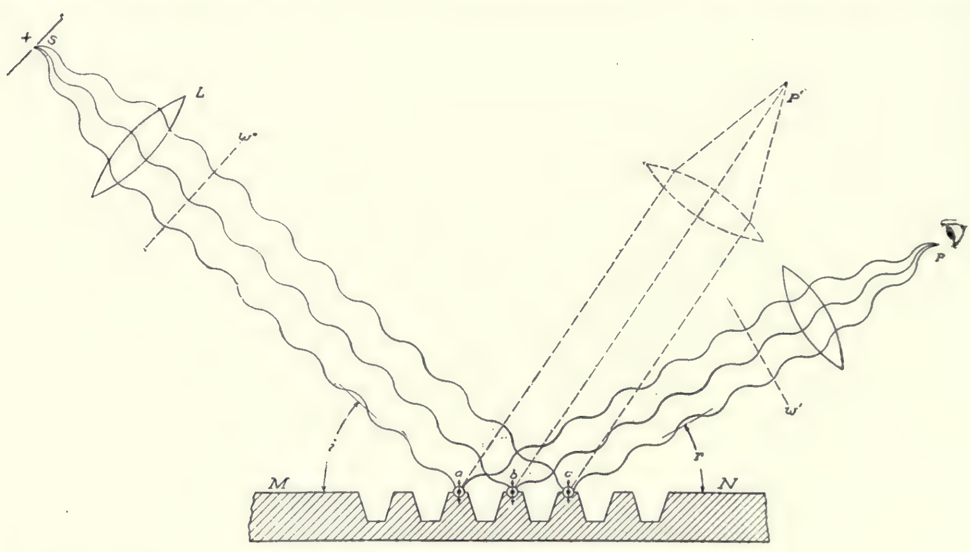


Fig. 1. Diffraction Grating Spectrometer.

train from each electron, just as a train of water waves is sent out by any vibrating object in water, or sound waves by a vibrating tuning-fork in the air. In the case of light the waves consist of electric force instead of water or air, but in all other respects they resemble water waves very closely. Picture an electron endowed with eyes standing at a point in the path of the ray of light. The electron will observe that the electric force at the point where he is standing is now upward, that is, in such a direction that an electrically charged body would be pulled upward by it, now downward, now up, now down, etc., in regular sequence, with a periodicity which is called the "frequency" of the light; and if, at the instant when a crest is passing him,

that is, when the electric force is upward and at maximum intensity, he looks backward to the next approaching crest, the distance to this crest is a wave-length of the light. The electron will also report that the electric force, instead of being alternately up and down, may be to the right and left respectively, or in any other direction at right angles to that in which the rays are travelling ; and that the electric force is always accompanied by a magnetic force at right angles to it. But being electrical, he will be chiefly concerned with the electric force, and since reflection depends on electrons, our interests are identical with his.

We may now give a picture of reflection. The observing electron of the preceding paragraph will experience the pull of the electric force, and, unless he is very firmly anchored—and we have good evidence that most of the electrons in matter are only loosely held to their positions in the atoms—will soon find himself riding on the wave, moving up and down in synchronism with it. And being electrical, he cannot oscillate in this way without sending out waves of electric force, like the electrons in hot bodies. These secondary waves constitute reflected light. The reflected rays are to be looked upon as new rays, not the primary ones turned back, although it is, of course, the same energy, slightly diminished, that appears in these reflected rays. A good analogy is a motor-generator generating alternating current of the same frequency as the primary current.

The Formation of Spectra.—The picture of reflection just given can now be applied to explain the separation of different wave-lengths of either X rays or ordinary light into a spectrum. To obtain the spectrum of a beam of ordinary light we select a small portion of it by means of a narrow slit *S*, Fig. 1, make its rays travel in parallel lines by a lens *L*, and let them fall on a grating *M-N*. The grating consists of a plate of glass or metal ruled with a large number of fine, parallel grooves. Those electrons in the grating surface upon which the light falls are set into oscillation by it and each one becomes a new source of light waves which it sends out in all directions.

In order to obtain the spectrum of our source of light we have only to add up these secondary wavelets, each with its proper phase. If the wavelets sent out by two electrons, *a* and *b*, Fig. 1, arrive at a point *P* in exactly opposite phase, the electric force due to one will always be downward when that due to the other is upward, and of the same magnitude, *i.e.*, we shall have at every instant two equal and opposite electric forces at that point. The resultant electric force will therefore be zero continuously, and if the eye be placed there the electrons in the retina that cause the sensation of sight will not be set into vibration. If, however, the waves arrive at *P* in the same phase, their electric forces add, and the light is doubled.

The wavelets from the grooved portions need not be considered, as their phase relations are so irregular that their resultant is always small. The locus of points at which the wavelets from the plane areas *a*, *b*, *c*, etc., arrive in the same phase may be found from geometry as follows :—

The forced oscillation of the electrons in the metal surface follows exactly

the exciting wave, so that the secondary wavelets, at the moment of starting out, are in phase with the primary. The relative phase of the different rays at P depends, therefore, only on the distances that the rays have to travel from S to P. A part of the distance, that from S and P to planes W_0 and W_1 perpendicular to the direction of the rays respectively, we know to be the same for all rays on account of the action of the lens, so that the distances to be compared are from W_0 to W_1. It is evident at once from the figure that this distance is exactly the same for all rays provided the "angle of incidence," SbM is equal to the "angle of reflection" PbN. This gives the law of ordinary reflection, and is true for all wave-lengths, and independently of whether the surface MN is continuous or broken by scratches. If the surface is continuous

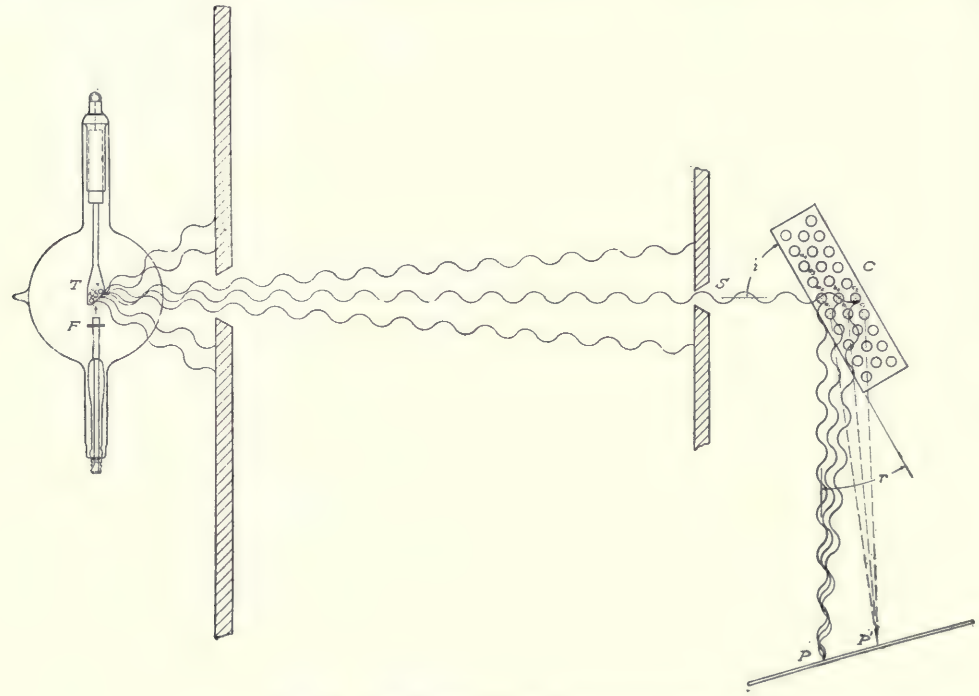


Fig. 2. The Crystal X-ray Spectrometer.

this is the only direction in which the secondary waves are all in phase, that is, this is the only direction in which light is reflected. But if the surface is broken by grooves equally spaced, there is another direction P' in which the optical distance S-P' for rays from consecutive plane areas (a, b, etc.) differs by just one wave-length, so that the wavelets from a arrive just one wave-length ahead of those from b, those from b one wave-length ahead of those from c, etc. They will thus be in phase at P' and light of this wave-length will be intense at P'. For a different wave-length the wavelets will not be in phase at P', but will be at some other point P''. Thus the different wave-lengths will be separated and form a spectrum.

It is also possible for the wavelets from a to arrive at some point exactly two, three, or four wave-lengths ahead of those from b, and so be in phase.

The spectra thus formed are called spectra of the "second order," "third order," etc. A photograph of the complete spectrum will generally contain several orders, some of them overlapping each other.

In the case of X rays the picture is still simpler; for the wave-lengths are so short that we are able to use for a grating a natural crystal such as rock-salt, in which the individual atoms take the place of the little faces *a*, *b*, *c*, of Fig. 1. Crystallography teaches that the atoms in crystals are arranged in regular, equidistant planes, and Prof. Bragg and his son have been able, by means of X-ray spectra, not only to confirm this hypothesis but to find the exact positions of the atoms. They find that the atoms in each plane are equally spaced in parallel rows. These rows of atoms correspond to the narrow plane surfaces between grooves in the diffraction grating. The only difference between the crystal and the grating is that the X rays penetrate several thousand planes deep, so that the crystal is like a pile of semi-transparent gratings, all equidistant and with their lines parallel.

The use of the crystal as a grating is shown graphically in Fig. 2, where F represents the hot filament cathode of the X-ray tube, T the target, C the crystal, and P the photographic plate. The electrons of the "cathode ray" stream fall upon the target and set the electrons of the atoms in its surface into violent vibration. It is easy to conceive how the frequency of vibration caused by one of these blows, from an electron moving with half the velocity of light, should be much higher than that caused by a bump from another atom, such as gives rise to the visible light of a hot body.

These vibrating electrons of the target send out the high frequency electric waves which we call X rays. They travel out in all directions, and a portion of them, passing through the narrow slit S, fall on the crystal C, and cause the electrons in its atoms to vibrate and radiate secondary wavelets. These secondary wavelets then travel to the photographic plate P and there reinforce or annul each other according to their phase relations, as in the case of the visible spectrum already discussed.

To find the proper phase relations it is best to proceed in two steps, first considering the atoms in a single plane, and then the relation of the planes to each other. For a single plane the phase relations are exactly the same as for the grating, since the plane with its rows of atoms acts just like a grating. We need, for the present purpose, only the first relation deduced above, namely, that the wavelets from all the atoms in the plane will be in phase with each other provided the angle of incidence of the rays on the plane is equal to the so-called "angle of reflection," the angle at which that part of the secondary rays which we are considering leaves the crystal. Any one atom in the plane may therefore represent the phase of all of them, provided we keep the angles of incidence and reflection equal.

The second part of the problem is to find under what conditions the wavelets from the atoms in the first plane are in phase with those from the second, etc. Let us take as representative atoms from the different planes, those which lie in a straight line parallel to the primary beam, as a_1, b_1, c_1, etc., Fig. 2. (If

necessary the planes may be imagined to slide over each other until these atoms are in line.) The primary wave *s a b c* reaches *b* later than *a*, so that the phase of oscillation of the electrons of *b*, and hence of the wavelets which they send out, will be behind those of *a*. The wavelets from *b* also have a greater distance to travel to *P* than those from *a*, so that they will be still more behind in phase when they arrive at *P*. If, however, they are a whole wave-length, or any whole number of wave-lengths behind, they will be in phase, and the electric forces of the two will add. Exactly the same relation will exist between the wavelets from *c* and *b*, *d* and *c*, etc., since the planes are equidistant. Hence the wavelets from all the atoms in the crystal will be in phase at *P* when two conditions are fulfilled: (1) the angle of incidence must be equal to the angle of reflection; (2) this angle must be such that the wavelets from successive planes differ in phase by some integral number of wave-lengths. We then obtain a registration on the photographic plate at *P* of one wave-length of the primary beam. For a different wave-length the wavelets will be in phase at some adjacent point *P′* on the photographic plate, provided we rotate the crystal until the angles of incidence and reflection are again equal, and of the proper value for this new wave-length. Thus by continuous rotation of the crystal, which is accomplished by a motor

Fig. 3. Visible Spectrum of Tungsten Vapour. (Wave Lengths in Aengstrom Units).

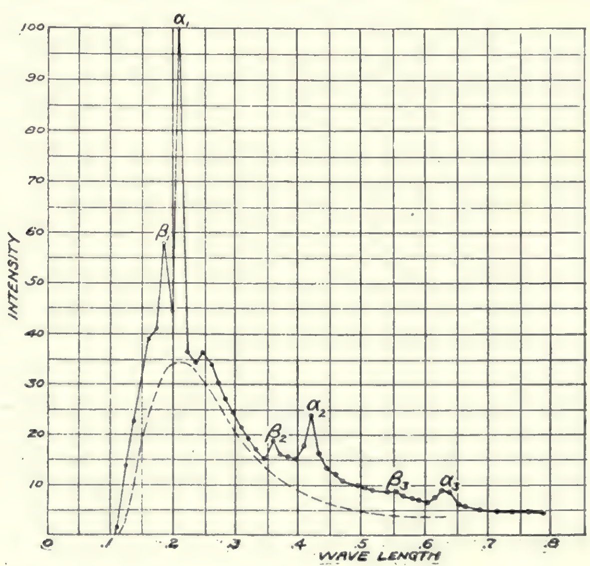


Fig. 4. X-ray Spectrum of Tungsten at 100,000 Volts, Obtained by the Ionization Chamber.

and worm gear, all the wave-lengths in the beam are successively registered.

According to the second condition given above, the same wave-length may be registered at several different positions on the plate, corresponding to phase

differences of one, two, three, etc., wave-lengths between wavelets from consecutive planes. Hence if the crystal is rotated far enough, several complete spectra will be obtained, called respectively the first, second, third, etc., order spectra. The intensity of the higher orders is very small, so that usually not more than three orders are visible. Fig. 6 shows the so-called "*K*" lines of tungsten in two orders, and Fig. 5 in three orders.

The photographic plate gives the correct values of the wave-lengths present in the beam, but not the intensity. In order to obtain this we make use of the fact that when X rays pass through a gas they make it electrically conducting. Hence if the rays are allowed to enter an "ionisation chamber," which consists simply of two oppositely charged plates, a current will flow through the gas between the plates. This current can be measured by a sensitive electrometer and is proportional, if the gas is dense enough to absorb nearly all the rays, to the intensity of the rays. Thus by putting the ionisation chamber in place of the photographic plate, and reading the electrometer at regular intervals while the crystal is being rotated, one obtains the intensities of all the wave-lengths in the spectrum. The spectrum shown in Fig. 4 was obtained in this way.

Description of the Spectrum.—The X-ray spectrum of tungsten, obtained as described above, is shown in Figs. 4, 5 and 6. It consists of a "continuous spectrum" extending over four octaves (from the wave-length $\lambda = 0{\cdot}12 \times 10^{-8}$ cm. to $\lambda = 2 \times 10^{-8}$ cm.), and 16 lines. Four of these lines on the short wave-length end of the spectrum are very close together and are known as the *K* series. They are usually designated as α^1, α, β and γ. In Fig. 5, these four lines appear as only two, the "α doublet" appearing as a single line, and the β and γ lines being likewise too close to appear separately. The other 12 lines form another group, with wave-lengths nearly ten times those of the *K* series, and are known as the *L* series.

Fig. 6 shows a photograph taken in the manner described above, with a Coolidge tube having a tungsten target, running at 100,000 volts and 1·2 milliamperes. The rock salt crystal (*C*, Fig. 2), was 40 cm. from the target *T* and 56 cm. from the photographic plate, and was kept in continuous rotation during the four-hour exposure.

The photograph shows three of the four "*K*" lines of tungsten, the α doublet and the strong β line, in the first and second orders (marked with subscripts 1 and 2 respectively). The γ line, which is just to the left of the β line, is too weak to show. The wave-lengths of these lines are 0·212, 0·208, and 0·185 Aengstrom units * for the two α lines and the β line respectively. The wave-length of the β line, which is the shortest line that has been observed in the tungsten X-ray spectrum, is a little less than $\frac{1}{10{,}000}$ of the wave-length of the shortest ultra-violet line ($\lambda = 2{,}700$ Aengstroms) that has been found in the spark spectrum of tungsten vapour.

* The Aengstrom unit $\frac{1}{100{,}000{,}000}$ cm., is the standard unit for expressing the wave-lengths of visible light, and is used here for the sake of comparison. The wave-length of ordinary green light is 5,000 Aengstrom units.

Fig. 5 is taken under the same conditions of current and voltage as Fig. 6, but the photographic plate was only one-third as far, 19 cm., from the crystal, and the crystal was rotated through a larger angle so as to obtain a larger portion of the spectrum. The time of exposure was six hours. On this photograph *C* is the undeviated primary beam of rays which has passed straight through the crystal, and marks the zero line from which to measure the lines on the spectrum. The wave-lengths of these lines are approximately proportional to their distance from this zero line, except for the lines of 2nd and 3rd order, whose distances must be divided by 2 and 3 respectively.

The wave-length marked λ_0 at the extreme left of the photograph, the shortest wave-length present in the spectrum, is connected in a very interesting

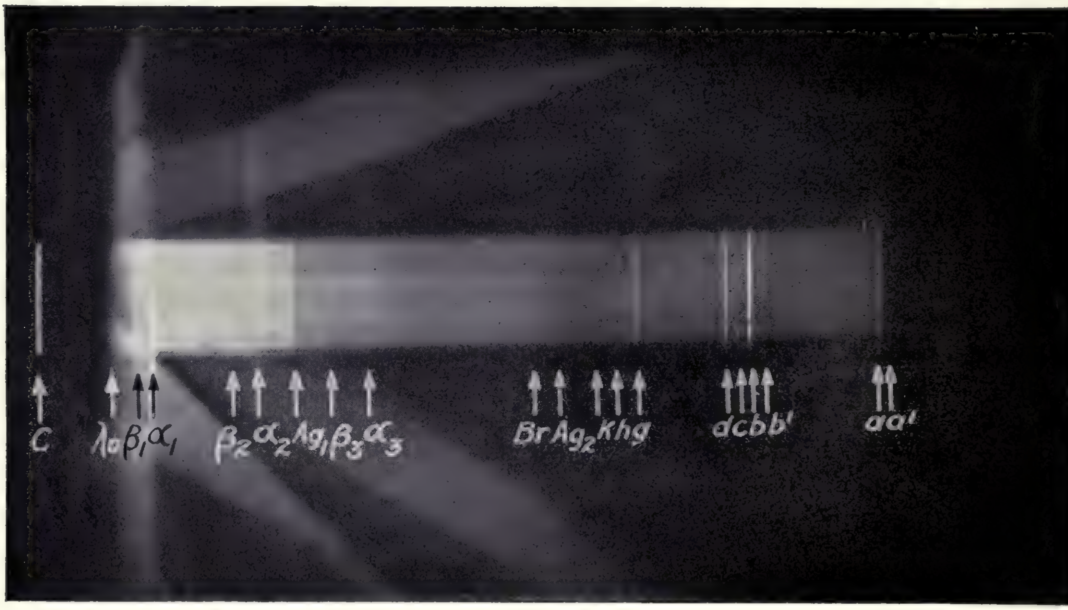


Fig. 5. Complete X-ray Spectrum of Tungsten at 100,000 Volts.

way with the velocity of the electrons which impinge upon the target in the X-ray tube, and produce the rays. If we speak in terms of frequency instead of wave-length, the frequency of this limiting wave-length multiplied by Planck's universal constant "h," the so-called "quantum," is exactly equal to the kinetic energy of the impinging electron. This relation has been checked over the whole range of voltage from 20,000 to 100,000 volts, and is more than a coincidence. It is another of the striking mathematical relations which the "quantum theory"* has brought to light, and which, though not at present understood, must have an extremely intimate connection with the mechanism of atomic structure.

The lines marked α_1, α_2, α_3, and β_1, β_2, β_3, are the first, second, and third orders respectively of the α and β lines of the "*K*" series. The two α lines show separately in the second order, but not in the first. The γ line is not visible.

* For a brief review of the quantum theory see Dushman, G. E. Rev., Sept., 1914.

The band whose edge is marked Ag_1 is an absorption band of the silver in the photographic plate. For all wave-lengths shorter than this wave-length Ag_1 (0·488 Aengstroms), silver has an especially strong absorption. Since photographic action depends upon the amount of light which the sensitive film absorbs, and since about 99 per cent. of the energy of X light goes through

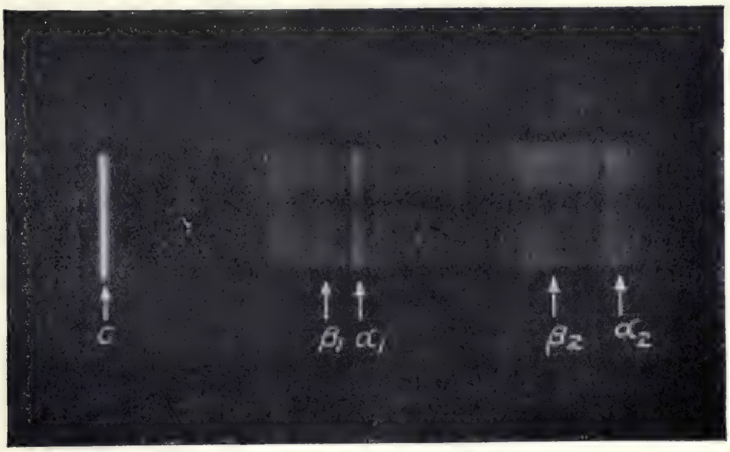


Fig. 6. X-ray Spectrum of Tungsten—The "K" Lines.

the plate without absorption, it is evident that an increase in the absorbing power of the silver will cause a large increase in blackening.

The band Ag_2 is also due to the silver, and is caused by the "second order" reflection of these same wave-lengths, striking the plate this time at a

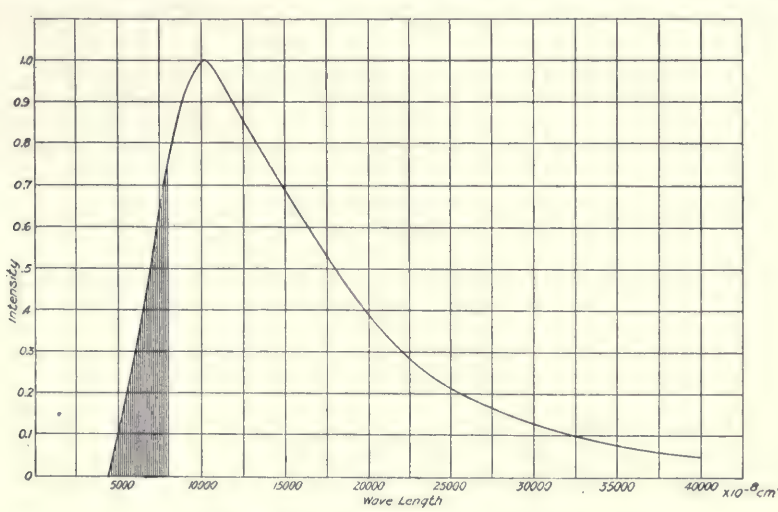


Fig. 7. Spectrum of Incandescent Solid Tungsten.

point twice as far from the central line C. In the same way the band Br is due to the special absorption, by the bromine atoms in the silver bromide of the photographic plate, of all wave-lengths shorter than 0·926 Aengstroms.

There is one other absorption band, which shows clearly on the original photograph, just to the left of Br. It is due to the special absorption, by the

minute trace of rubidium in the glass of the X-ray bulb, of all wave-lengths shorter than 0·79 Aengstroms. In this case special absorption means a loss of light to the photographic plate, hence the spectrum to the left of *Rb* is less black than that to the right. The absorption bands due to the other constituents of the glass fall too far to the right to show on the photograph.

All known elements have these X-ray absorption bands, and their positions are much more regular and more simply related to the material than are the bands in the visible spectrum. As far as known every element has two absorption bands for X rays, one beginning at a wave-length just beyond its *K* series on the short wave-length side, the other just beyond its *L* series. The wave-lengths at which each of these bands begin, for the different elements, are very nearly proportional, inversely, to the squares of the "atomic numbers" of the respective elements.* The physical meaning of this relation also, like the quantum, is not yet known. Its simplicity and exactness give it significance.

The rest of the lines, those to the right of Ag_2, all belong to the "*L*" series. For convenience of identification they are lettered *a*-*k*. Their wave-lengths range from 1·47 Aengstroms for "*a*" to 1·033 for "*k*." They are all in the first order.

For the purpose of comparison the spectrum of tungsten vapour, made luminous by an electric spark, is shown in Fig. 3. The lines do not show very clearly because they are so numerous. Compared with the complexity of these visible spectra, some of which contain as many as 60,000 lines, the X-ray spectra are strikingly simple. This simplicity makes the X-ray spectra especially useful, both for scientific investigation and as a means of chemical analysis.

The continuous spectrum, which appears as a continuous background in Figs. 5 and 6, is shown graphically in Fig. 4. This was obtained by the use of an ionisation chamber and electrometer, in place of the photographic plate, as explained above. The current and voltage were the same as for Figs. 5 and 6, viz., 100,000 volts and 1·2 milliamperes. The ordinates of points on the curve give the intensity of the corresponding wave-lengths, whose values, in Aengstroms, are given by the abscissas. The circles mark the experimental measurements as read from the electrometer.

The curve shows clearly the repetition in the first, second and third orders of the α and β lines shown in the photographs of Figs. 5 and 6. It also shows the relative intensity of the lines as compared with the continuous spectrum upon which they are superimposed. The continuous spectrum is, like the lines, present in all three orders, so that to obtain the true relative intensity of the different wave-lengths in the beam it is necessary to separate these different orders. This has been done for a lower voltage, 70,000, and the

* The atomic number of an element is the number of its position in a table arranged according to atomic weight, beginning with hydrogen equal to one, helium two, etc. It has been found to be more intimately connected with the chemical properties of the atom than the atomic weight, and is probably very closely related to the number of electrons in the atom.

resulting values are shown in the dotted curve, Fig. 4. Here the K lines are absent, as the voltage, 70,000, was not high enough to excite them. For comparison the visible and infra-red spectrum of incandescent tungsten at 2,200° C., which is approximately the temperature of the filament of a Mazda lamp, is given in Fig. 7. The shaded portion represents the visible part. If the wave-lengths in Fig. 7 were all reduced ten thousand fold, it would coincide very nearly with the dotted curve in Fig. 4.

REPORTS OF SOCIETIES.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN.

At the Sixty-first Annual Exhibition of the Royal Photographic Society of Great Britain, held in London recently, X-ray work was represented by an excellent series of prints by Dr. Robert Knox and Mr. Holland, one of which, of the stomach and intestine, was made with an exposure of as short a period as $\frac{1}{100}$ of a second. The results contributed by the combined efforts of these two workers attracted considerable attention, and very ably represented the progress that has been made in radiography during the last decade.

A further set of radiographs by these two workers and by Drs. E. S. Worrall and C. Thurstan Holland, the President this year of the Röntgen Society, was shown as the nucleus of a collection of X-ray and scientific prints now being collected by the Executive Committee of the Affiliated Societies of the R.P.S., to be presented in portfolio form to colonial photographic societies.

The subjects of these latter prints were very varied, joint and bone injury, calculi in kidney, and several cases of bullet and shrapnel injuries so much in evidence at the present time.

Two radiographs in pseudo-relief of shells, showing their internal structure, were interesting and of good technical quality. These were contributed by Dr. Geo. H. Rodman, F.R.P.S.

A frame of auto-radiographs of radium-bearing minerals, by Mr. J. H. Gardiner, F.C.S., was a novelty to many of the visitors to the exhibition. These are contact impressions on sensitive plates placed against flattened sections of radio-active minerals, the records providing information as to the particular distribution and intensity of the active constituents. It may be remembered that Mr. Gardiner described the process of the production of these prints at a recent meeting of the Röntgen Society, and particulars of the exhibit was published in the last number of the "Röntgen Journal."

RÖNTGEN SOCIETY.

Annual General Meeting, June 6th, 1916.

HOMOGENEITY OF VISIBLE RADIATION.

By Professor J. W. Nicholson, M.A., D.Sc.

In your address at the beginning of this Session, Mr. President, you chose the subject of spectra. Perhaps we are justified in returning to this more philosophical study after a year spent on very practical and urgent matters in the main. I hope to-night to give an account of some recent work done by Dr. Merton and myself which, while concerned entirely, as it stands, with visible radiation as manifested in spectra, is not without suggestions of problems of a corresponding nature which come more completely into the scope of our Society,—perhaps I should use the future tense, for the study of X rays, though they are light-waves of short wave-length, has not yet reached the stage at which the present kind of problem can be discussed with much profit; we can only content ourselves with a realization of the ultimate problems which X rays will present, by drawing a parallel between them and

visible radiation as regards certain characteristics of the latter, which I am about to describe.

The title of my remarks conveys an attempt to draw this parallel. We all know what a homogeneous X-radiation means. It denotes radiation with a specified wave-length, and I am venturing to apply the same term to visible light. For our present purpose, homogeneous visible light will mean absolutely monochromatic light forming an image, on the photographic plate, of the slit of a spectroscope. In other words, it denotes something purely ideal, for however narrow a slit may be used, any spectrum line actually seen or photographed has in all cases a definite breadth. Every spectrum line includes, in fact, an indefinite number of images of the slit side by side, formed by different wave-lengths which lie, in so far as they affect the photographic plate, within a certain narrow range, but can take any value within that range, so that the set of slit-images appears as a broad band. The intensity of the band shades to zero on either side, becoming zero when the light of the corresponding wave length is not strong enough to affect the plate. In fact there is a certain wave-length, giving its image near the centre of the band, which is stronger than all the others, and it represents the natural vibration or "note" of the vibrating atom, produced from its interior. If the atom as a whole is moving, the apparent note is changed, as is the acoustic note of a moving railway whistle. Now in a collection of vibrating atoms of a gas through which a discharge passes, bodily motions of every magnitude are going on, and atoms with a specified velocity in the line of sight will give a note differing by a slight, but specified amount from the natural note. We get therefore a range of frequency or wave-length as in the band, and for the higher velocities, the number of atoms possessing them is small, and the corresponding wave-lengths are not strong enough to affect the plate.

We are, of course, at this point on familiar ground. Lord Rayleigh has in fact given a very complete theory of the broadening of spectrum lines into bands in this way, and the theoretical laws deduced are in accordance with experiment. They have even led to a knowledge of the relative masses of the atoms emitting the lines which would be monochromatic in the absence of bodily movement of atoms. But I have traversed the ground because the structure and breadth of spectrum lines is to be the subject of all my remarks,—and it may be said that the Röntgen ray may exhibit the same type of phenomena in a greater or less degree. This is for the future to decide. The nearest thing to homogeneous radiation that we can devise turns out to be in reality far from homogeneous when closely examined.

The broadening of spectrum lines described already is the so-called normal type, and is produced in the spectrum of any gas when excited in the ordinary way in a tube in which it is sufficiently vacuous. If the gas is denser, other effects come into play which are not our concern on this occasion. The normal broadening is produced by the normal discharge. When a condenser of variable capacity is put into the discharge circuit, we obtain the condensed discharge, and as the capacity is increased, the spectrum lines broaden in a quite anomalous way. Their breadth can become very great, and they do not always shade off equally on either side. Into the cause of these effects I propose to enter.

We are all familiar with the Zeeman effect, or the splitting up of a spectrum line into several different ones by the agency of a magnetic field. This phenomenon is fairly well understood on its theoretical side. But Stark and Lo Surdo showed very recently—the war has naturally diverted attention from this remarkable phenomenon—that a very strong electric field can split a line into a very complicated set of individual lines in the simplest spectra we know. This phenomenon, which has at present no satisfactory explanation in theory, will without doubt lead ultimately to very precise information as regards the atoms of bodies and the mechanism of their emission of every type of radiation. It would take me too long to enter into details of individual cases, and it will not be necessary. But we have another indication that the homogeneity of emission of radiation by a body depends very much on circumstances.

This is not even a case of a body preferring to emit one of its spectra rather than another, but represents an actual modification of one spectrum. The Hydrogen line Hγ, with two components in the ordinary way, has twenty-seven when a field of thousands of volts per centimetre is applied, and the separation between any two increases proportionally to this field.

Stark had suggested that this phenomenon perhaps lay at the root of the anomalous broadening under the condensed discharge,—that is to say, that under these conditions, the spectrum line was split up into many individuals, each being so broad—by virtue of atomic velocity, perhaps—that they all overlapped and gave a wide band. The experiments of Dr. Merton and myself were designed to test this point, in the first place, and more generally to obtain a method of accurate measurement of the distribution of intensity among the wave-lengths close together in one composite line under any conditions of excitement. Into the difficulties inherent in other suggested methods I have no time to enter. Perhaps, with other important points I must neglect, they may appear in the discussion afterwards.

The apparatus consists merely of the usual spectroscopic equipment with an accessory. This accessory is a neutral-tinted wedge, cemented to a similar wedge of clear glass, and mounted immediately in front of the slit of the spectroscope. The absorption of light by the wedge is not selective, and the wedge is so arranged that the slit is parallel to the direction of maximum increase of thickness of the wedge. The upper part of any spectrum line is therefore attenuated by the greater absorption of the wedge at this end, and as seen on the photographic plate, its ength is shortened, terminating at the point where the thickness of wedge traversed is just sufficient to reduce the original intensity to the intensity which can just affect the plate, under the conditions of exposure adopted. The slit image corresponding to the most intense wave-length will be the longest, and the less intense wave-lengths give shorter images. A curve can be traced through the top ends of all the images, and it is this curve for which measurements can be made at leisure on the photographic plate, after development and enlargement, and as the law of absorption in the wedge is known, it is possible to calculate theoretically, from the shape of this curve, the law of distribution of intensity across the original spectrum line or band. Into the details or method of this calculation I shall not go, but it is sufficient to say that two main results can be enunciated. If a spectrum line is merely broadened by atomic velocities after the manner of Lord Rayleigh's theory, and consists of one component in the absence of this broadening, the curve obtained on the photograph should be a parabola, of smooth and regular curvature, sloping downwards equally on both sides of its apex, which should be rounded. If, on the other hand, the law of intensity distribution is the simple exponential one, not capable of production by the kinetic theory distribution of atomic velocities, every individual component should give a definite *peak* on the curve, from which it slopes down as a straight line on either side. If several broadened components overlap, as Stark suggested, a composite curve is obtained, which exhibits either a peak, or a protuberance more or less rounded, at the place where any component has its maximum intensity. These peaks and protuberances can be seen on the photographs by inspection, and the relative positions of the components of a composite line deduced from them by direct measurement on the plate.

The eye is notoriously inefficient as a detector of small differences of intensity on a blackened photographic plate. To attempt an accurate quantitative estimate of the intensity distribution across a band by any measurement of degree of blackening on a plate, and its variations, would be impracticable. The method described has the advantage of removing any such necessity. A variation of intensity in one direction is by this method balanced by a known variation in the perpendicular direction, and the boundary of the photograph is the assemblage of points where the balance occurs. Its shape therefore gives the unknown variation, and in particular at once picks out the places where any new line—even a weak one—is superposed on some part of

the breadth of another. I have not found it possible, as I had hoped, to have some of our photographs here to-night, but some figures on the board will bring out their characteristics.

The photographs obtained in this way with the condensed discharge are in complete agreement, both qualitative and quantitative, with our expectations on the basis of Stark's suggestion as to the cause of abnormal broadening. The separate components are present, as shown by the kinks in the boundaries; I refer more particularly to the Hydrogen line H ∞, which we have examined most exhaustively, although other hydrogen lines, and those of Lithium and Helium which we have employed, fall into line. The ratios of the horizontal distances between these kinks are moreover the ratios of the distances between Stark's components, thus completing the proof. In the condensed discharge, therefore, the same splitting up of lines occurs as we get with a field of such an order as 30,000 volts per centimetre applied directly to the tube. For the separations between the components are comparable with those of Stark.

Each of these new component wave-lengths is broad enough to overlap its neighbours, but the breadth has quite another origin from the breadth of a line in the ordinary discharge. It cannot be ascribed to atomic velocities in the manner of a Doppler effect, for the distribution of intensity across each component follows quite a different law—the simple exponential. We are in presence of two phenomena, firstly, the existence of the different wave-lengths, and secondly, their curious broadening. One general characteristic is that they become broader—quite apart from their intensity—as they recede on either side from the central line as given by the ordinary discharge.

We have concluded that the origin of anomalous broadening in the condensed discharge has been found. It is the Stark effect, or electric Zeeman effect. But as I have said, no theory of a satisfactory kind has been put forward as to what the Stark effect means in connection with radiation, and I am unable to suggest one. It is only possible to maintain that whatever it means, we have another means of studying it in the condensed discharge. As to its appearance there, without the application of a high voltage, there is no difficulty if we take it that the atoms get closer together in their disturbance by condensed discharge, even to the extent of interpenetration. An electron actually passing through an atom can easily produce, as calculation shows, a *local* voltage of the necessary magnitude. In fact, the atoms are themselves made to do the work, instead of applying this work directly outside the whole assemblage.

I am afraid many points have only been touched on in this account and very imperfectly elucidated. But the subject of modifying the radiation from atoms is so wide that questions arise at every point, and I am therefore encouraged to think that any further details of our experimental method and its future application, together with the further interpretations of these preliminary results, are more appropriate for the discussion. I therefore leave them at this point.

Royal Society of Medicine, March 17, 1916.

DISCUSSION ON EXPERIMENTS AND EXPERIENCES WITH THE COOLIDGE TUBE.

Opened by Robert Knox, M.D.

(Continued from page 233).

Experiment VI.—Two negatives were taken with short exposures, with 30 ma. in the tube and a spark-gap of $4\frac{1}{8}$ in., the exposures being approximately $\frac{1}{4}$ sec. and 1 sec. A second pair of negatives were taken with a much shorter spark-gap (about 2 in.), with 45 ma. in the secondary, and exposures of 5 sec. and 20 sec. respectively. The four negatives were on a 15 in. by 12 in. plate. The first, A, was rather under-developed, but any one of the other three could have been developed into a good negative. The full particulars were:—

	Heating current amperes	Milliamperes	Spark-gap inches	Time seconds	Milliampere seconds
Set A	4·3	30	$4\frac{1}{8}$	$\frac{1}{4}$	$7\frac{1}{2}$
	4·3	30	$4\frac{1}{8}$	1	30
Set B	4·42	45	2	5	225
	4·42	45	2	20	900

This experiment shows the difference in the spark-gap in the two sets, and the remarkable differences in the milliampere seconds exposure, varying from $7\frac{1}{2}$ ma. to 900 ma. sec.

Experiment VII.—It has been suggested that the Coolidge tube is not so good for radiographic work as an ordinary tube. To determine this point four radiograms were taken, two (*A* and *B*) with a Macalaster-Wiggin tube with a very sharp focus, and two (*C* and *D*) with the Coolidge tube used in the other experiments. The exposures were the same in each, and the other factors were also equal. The result is shown in Figs. 12, 13, 14, and 15. All four are good negatives. The two taken with the Macalaster-Wiggin tube are, if anything, the better plates, but they do not demonstrate any marked superiority.

Experiment VIII. (Fig. 16).—Meat about $\frac{3}{4}$ in. thick, wrapped round bone above and below.

	Heating current amperes	Spark-gap	Milliamperes	Seconds
A	3·75	$4\frac{3}{4}$ in.	$4\frac{1}{2}$	12
B	4·0	$1\frac{3}{4}$,,	12	30
C	3·92	$3\frac{1}{4}$,,	9	10
D	4·12	$6\frac{1}{4}$,,	27	$1\frac{1}{2}$

Experiment IX was a repetition of Experiment VIII, with shorter times of exposure, the former being considerably over-exposed.

The Coolidge Tube in Therapeutics.

The Coolidge tube has been shown to be of proved utility in radiography, and if its reputation depended on that alone it would have amply substantiated the claims made for it, but it possesses still greater advantages when used in therapeutic work. To those of us who have been engaged in this work practically from its infancy, it is hardly too much to say that the Coolidge tube is by far the most efficient tube we have yet had the opportunity of using, and it would be difficult to conceive of any improvements which would be likely to make it more efficient. Within reasonable limits of safety, so far as the tube is concerned, it may be used for many hours daily, and at the end of the day still be able to continue its output of uniform radiations.

The following experiments were carried out with a view to ascertaining the best conditions for the working of the tube. Since the Coolidge tube has been used at the Cancer Hospital

we have had three tubes; the following figures will show the working value: 2,228 doses have been given in a period of several months, amounting in all to 310 hours, at an average of 8 min. per dose; most of these were given through 3 mm. or 4 mm. of aluminium. Of the three tubes one was worn out after having been used for over 800 exposures; it was repaired at a cost of £20, the original price being £25. Taking the cost of the tube at £25, this works out at an average of 7½d. per dose, not an excessive price to pay for a deep irradiation. During the time these tubes were in use two other tubes were damaged, but this was the result of accident incidental to all tubes, and the damage was not done while the tubes were actually at work.

Apparatus.

The apparatus used in the experiments consisted of:—

(1) *High-tension Transformer.*

(2) *Large Induction Coil.*—Spark-gap estimated at over 20 in. This was used in all its combinations—namely, one-, two-, and three-point electrolytic interrupter, three windings of primary, and in various combinations of these factors. The mercury interrupter was also tried with the three primary windings.

(3) *Small Coil.*—Sixteen-inch spark-gap specially constructed for therapeutic work. A mercury jet break was used. It was worked with coal gas as the dielectric.

The high-tension transformer in its present condition was quickly ruled out of the experiments, it being found that for ordinary therapeutic work the coil outfit was by far the most efficient and economical.

The best all-round conditions were obtained with: (*a*) The large coil, working on No. 1 primary, and the two-point electrolytic interrupter; (*b*) the small coil, with the mercury interrupter.

The conditions under which the *large coil* was worked were: Heating current, 3·95 amp.; amperes in primary, 6; spark-gap, 7·5 in.; milliamperes, 6; time, 4 min. to produce a pastille dose at 10 in. from the anticathode of the tube.

The Small Coil (16-in. spark-gap).—Heating current, 4 amp.; primary current, 4 amp.; milliamperes, 4; spark-gap, 9 in.; time, 4 min. to produce 10 X or tint B. The interrupter was worked at its lowest speed.

This was found to be the best average condition for therapeutic work, and is the arrangement we generally use with the Coolidge tube. There are variations from this which can be obtained for special occasions; the length of the spark-gap can be increased. This might be done with a number of variations in the apparatus. The longest spark-gap obtained was 13·25 in. This was obtained with the large coil, working on No. 3 primary, and the mercury interrupter, with 7 amp. primary current and 0·8 ma. in the secondary. The heating current was 3·5 amp.

Time factor in dosage: Working at a distance of 10 in. from the anticathode, the shortest time in which a pastille dose could be obtained was 2½ min. This was done in two combinations of apparatus, namely:—

(1) *Large Coil.* — Two-primary winding. Two-point electrolytic interrupter; heating current, 3·8 amp.; primary current, 7 amp.; spark-gap, 8·7 in.; milliamperes, 4·5; time, 2½ min.

(2) *Small Coil.*—Heating current, 4 amp.; primary current, 8 amp.; spark-gap, 6 in. milliamperes, 12; time, 2½ min.

Heating Current.—The range employed in the large number of experiments varied from 3·2 amp. to 4 amp. in all possible combinations at our disposal, and in the endeavour to find out the best working conditions a large number of experiments were carried out. The results obtained are charted on a scaled paper, but I shall only refer to it, as it is much too intricate and at the present time too unstable to allow of any definite statements. The charts shown will give some idea of the amount of time which has been spent on these investigations, which are still in the initial stage and which, when completed, may produce some useful data upon which to base our future work.

TABLE TO SHOW VARIOUS COMBINATIONS OF APPARATUS USED AND TIME TO PRODUCE THE B TINT ON SABOURAUD AND NOIRE PASTILLES.

(*Sabouraud pastille 10 in. from Coolidge anticathode.*)

Primary in amperes	Spark in inches	Milli-amperes in tube	Heating current in amperes	Time in minutes to colour Tint B	Apparatus employed
3·5	8·5	3·9	4·0	8·0	Small coil; mercury break
4·0	9·0	4·0	4·0	4·0	Small coil; mercury break
6·0	7·5	6·0	3·95	4·0	Big coil; No. 1, primary; No. 2, electrolytic
7·0	8·75	4·5	3·8	2·5	Big coil; No. 2, primary; No. 2, electrolytic
8·0	6·0	12·0	4·0	2·5	Big coil; No. 3, primary; mercury break
9·0	4·0	18·0	4.0	3·0	Big coil; No. 1, primary; No. 2, electrolytic
15·0	7·25	4·75	3·5	10·0	Transformer
16·0	7·0	2·0	3·2	14·0	Transformer
17·0	8·25	2·5	3·475	12·0	Transformer
17·0	8·0	3·75	3·45	10·0	Transformer
17·0	5·0	10·0	3·75	5·0	Transformer

The next stage of our investigations took the form of a number of experiments with a fixed and rotating tube. The development of the rotating tube is the outcome of an attempt to improve upon the technique at present used in the treatment of deep-seated diseases. The suggestion to rotate the tube was made by Mr. C. E. S. Phillips; the mechanical details of the apparatus have been worked out and the instrument made by Mr. St. George Caulfeild; the experiments which illustrate this communication have been carried out for me by Mr. Caulfeild and Mr. Westlake at the Cancer Hospital. In order to explain the manner in which the results have been obtained, it will be necessary to describe briefly the apparatus employed.*

In passing it will be well to point out that the apparatus is at present in the experimental stage; but that as time elapses and experience dictates the future form which this instrument may take it will be modified; the underlying principles which led to its construction will, however, remain unchanged.

The experiments conducted so far have been made in order to ascertain the best method of using the new apparatus. The employment of X rays for the localization of foreign bodies directed our thoughts to the practicability of employing the central ray of the focus tube in therapeutics, the object being to direct the ray to a definite spot in the interior of the body. The principles employed in localization are quite applicable to the perfection of a technique for therapy, and rules found to be of value in the former are equally applicable to the latter. The principle on which the tube-stand is based is that of the simple rotation of the tube over the part to be irradiated, the beam of rays emerging from the aperture in the tube box being projected into the interior of the body at an angle which can be determined beforehand. The result of this angular projection of the sheaf of rays when the tube box is rotated is to describe a circle upon the skin surface; proceeding from this circle the converging rays meet at a point X; at this point the rays cross to diverge, and to emerge from or to be absorbed by the tissues beyond the focus point. The central ray is ascertained, the tube fixed to the stand, and by mechanical adjustments the rays may be projected into the interior of the body with an accuracy which is as surprising as its projection is simple. Moreover, the rays can be centred at any point and at any depth from the surface.

METHOD OF ESTIMATION OF THE DOSAGE.

A slow-contact Wellington bromide paper, quarter-plate size, was used. A standard scale was prepared, based on the time taken to change a Sabouraud pastille from the A to the B tint, ten graduations of colour being obtained. The same make of paper was used and the same strength of developer employed for the development of the strips used in the experiments; the same developer was used for each set of experiments. The accuracy of this method of measure-

* Described in the "Archives," Nov., 1915.

FIG. 8 (Experiment VI).

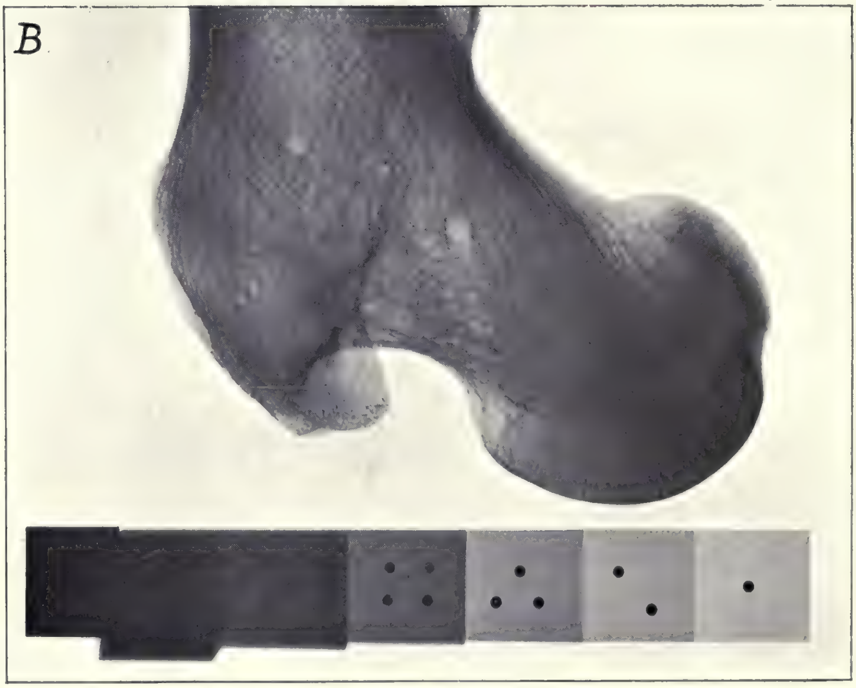


FIG. 9 (Experiment VI).

Fig. 10 (Experiment VI).

Fig. 11 (Experiment VI).

FIG. 12 (Experiment VII).

FIG. 13 (Experiment VII).

Fig. 14 (Experiment VII).

Fig. 15 (Experiment VII).

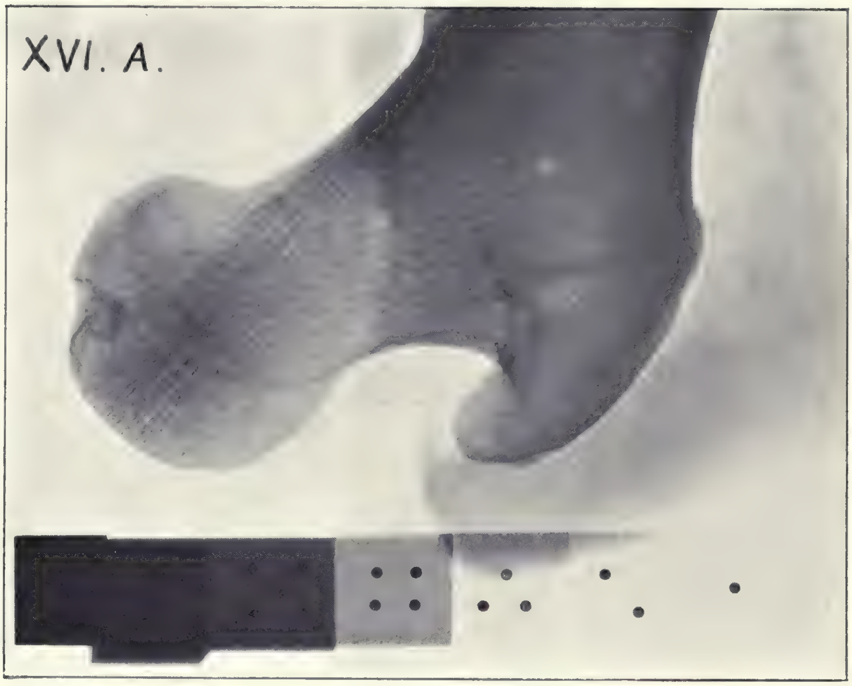


FIG. 16 (Experiment VIII).

FIG. 17 (Experiment VIII).

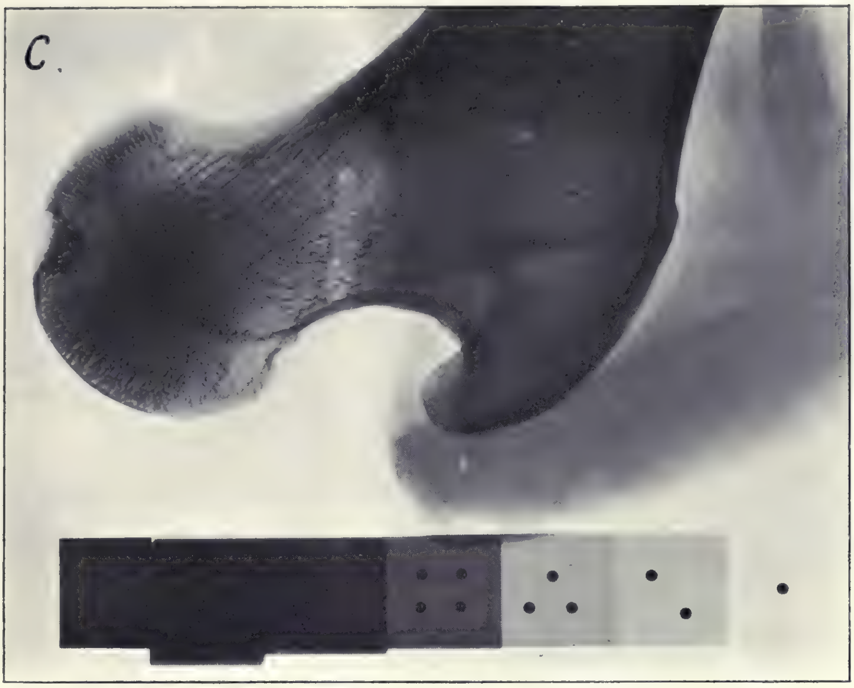
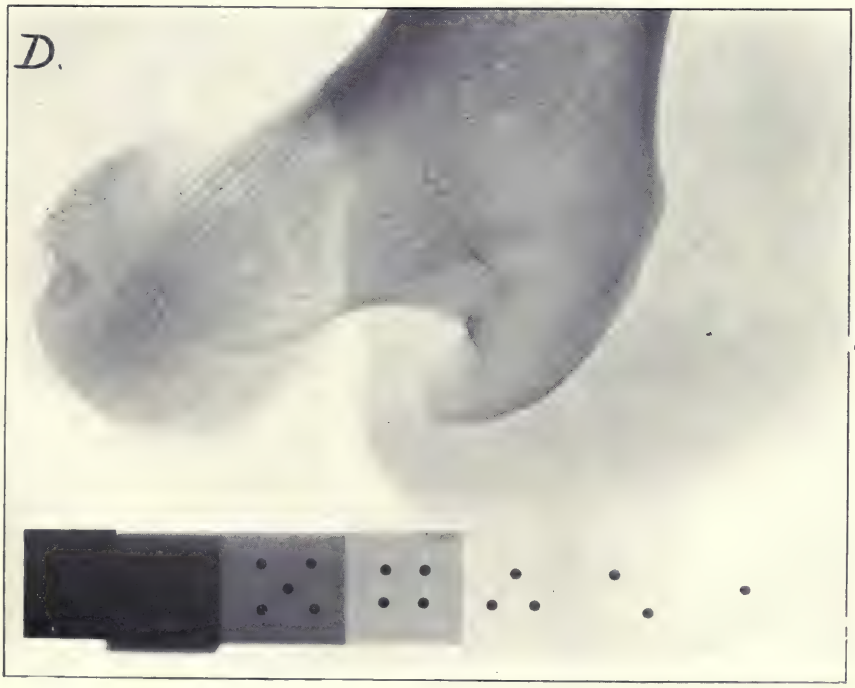


Fig. 18 (Experiment VIII).



19 (Experiment VIII).

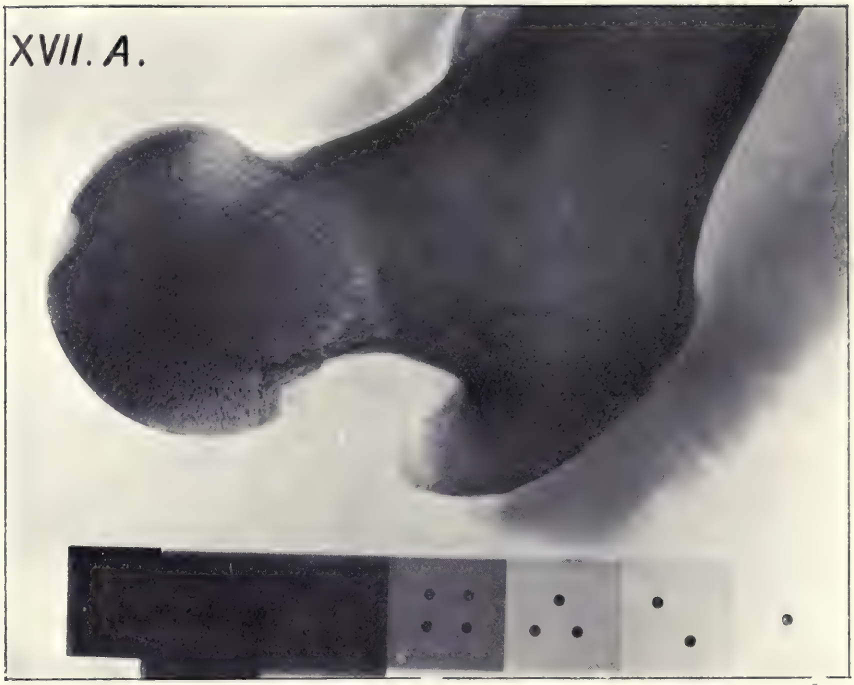


FIG. 20 (Experiment IX).

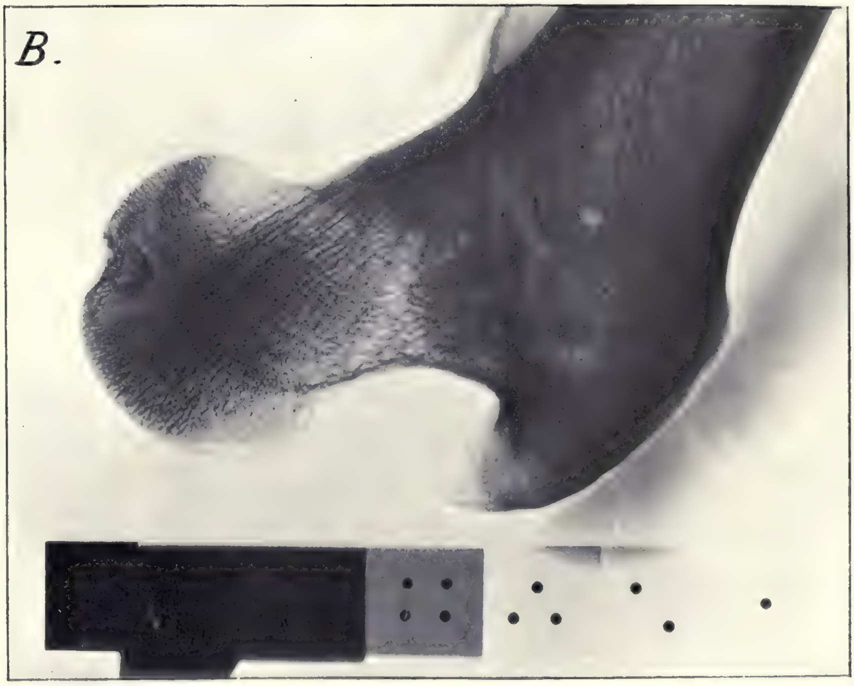


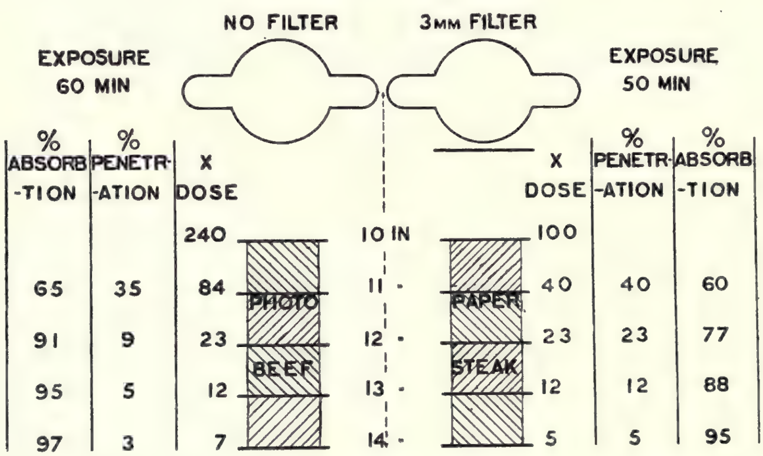
FIG. 21 (Experiment IX).

FIG. 22 (Experiment IX).

FIG. 23 (Experiment IX).

ment is open to question, but as the results are experimental and comparative only, the errors common to the method will apply to all the experiments, and should in no way prejudice the comparative results. A small hole, ½ in. in diameter, cut in a thick sheet of lead was used as a diaphragm in all the experiments (rotating). The distance from the target to the diaphragm was 6 in., from the target to the skin, 12 in., and to the focus point 16 in. An exception was made to this measurement in the experiment of the penetration through beef with the fixed tube. All the experiments were carried out with the Coolidge tube. A 16-in. coil with a mercury break was used in the majority of the cases, a high-tension transformer being employed in a few. On account of the variations between the two types of apparatus it was thought better to use a coil outfit for all. The differences between the two, the heating effect of the transformer on the tube, and the lesser output of hard rays when compared with those from the coil gave data which, when completed, may form the basis of another communication. It is sufficient for the present to state that the practical conclusion arrived at from these comparisons was, that for general value the coil is far and away more efficient for deep therapeutic work; it gives a more penetrating ray at the cost of much less primary current and with a smaller milliamperage. The coil was a 16-in. one, especially wound for therapeutic work, the break was a large mercury jet one with gas dielectric. The conditions under which the coil and tube were worked are given with each set of experiments.

Experiment A.—Comparison of the Effect on Unfiltered and Filtered Rays through 4 in. of Beef.



PENETRATION OF UNFILTERED & FILTERED RAYS THROUGH FOUR INCHES OF BEEF STEAK

MERCURY BREAK, COOLIDGE TUBE. HEAT 4 AMPS, AMPS. 4, MA. 4, SPARK-GAP 9 IN.

Fig. 29.

Twenty 3-min. runs of tube; total exposure, 60 min.	Ten 5-min. runs; total exposure, 50 min.

Four pieces of beef 1 in. thick; paper on top and between each piece of beef; one paper at lowest level, 4 in.

In the experiments with the fixed tube, the diaphragm had a larger opening, a 2-in. hole being used. The distances were the same as in the experiments with the rotating tube, with the exception already mentioned. If the larger opening had been used in the rotating experiments, the readings at the skin level would have been slightly higher, as the same strip of paper would have been exposed to the radiations for a somewhat longer period. This point will be experimentally dealt with at a later date.

CURVES CHARTED TO SHOW THE PREVIOUS EXPERIMENT.

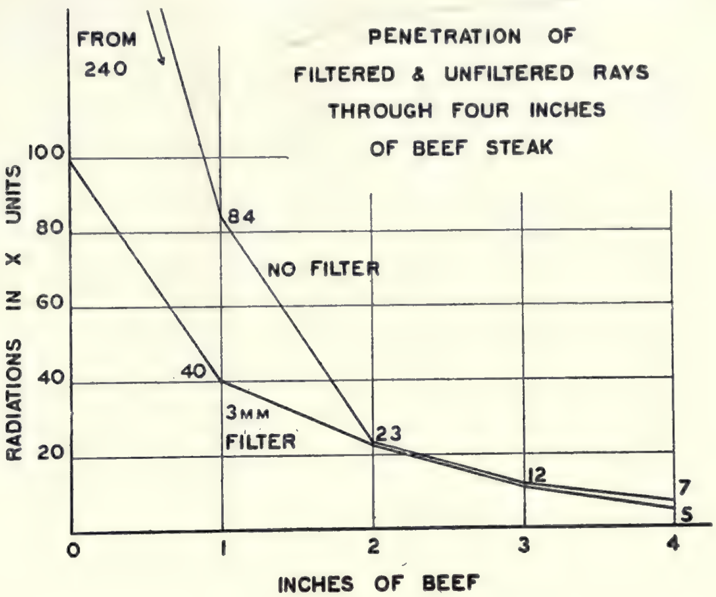


FIG. 30.

The curves representing the filtered and unfiltered rays come to the same value 2 in. from the skin, and follow each other down to the beginning of the fourth inch, where the filtered ray has rather less value than the unfiltered rays. This showing may be the result of a slight experimental error. The unfiltered skin dose is 2·40 X ; focus dose, 7 X in 60 min. The filtered skin dose is 100 X ; focus dose, 5 X in 50 min. The distance from the Coolidge target, 10 in., 11 in., 12 in., 13 in., and 14 in.

(To be continued).

REVIEWS.

Diseases of Children. By A. DINGWALL FORDYCE, M.D. Edin., F.R.C.P Edin. London : A. and C. Black, Ltd. 1916. Price 10s. 6d. net.

"Diseases of Children," by Dr. A. Dingwall Fordyce, the latest volume of the Edinburgh Medical Series, is an attempt to compress the whole subject into a compact and handy volume, and almost necessarily results in disproportionate attention being paid to the various diseases.

Its chief defect is that the author persists in regarding a child as a " 'pocket' adult," and explains wherein a disease in the child differs from the same disease in the adult, as if the latter were the type and the former a deviation therefrom—a common fallacy, but a peculiarly bad one in a book devoted to disease in children.

The didactic style adopted is pardonable in what is meant to be a text-book for students, but such a statement as "acquired syphilis is not a very rare disease" in infants should not be allowed to go unchallenged, for surely the author's experience must be unique.

The statement too that "Flexner's serum is of no avail" in the treatment of posterior basal meningitis, is not borne out by the results obtained by its proper use in the earliest stages of that disease.

The book suffers as a whole from a lack of detail, especially in relation to treatment, which is apt to be too stereotyped, and shows a want of familiarity with many of the more

recent advances, *e.g.*, in the treatment of poliomyelitis.

Again, as regards the use of X rays in diagnosis there are some good illustrations, but only such as were available some years ago, later advances in this branch not being shown.

The question of feeding in infancy and childhood occupies a large and, perhaps, the best portion of the book, as was only to be expected of the author.

For wrong descriptions under several of the plates, and for the scanty index, presumably the "loosened dogs of war" which Dr. Fordyce draws attention to in a topical preface are to blame, as we understand the book had to be "seen through" the press in a short interval between two periods of active service.

On the whole the book is a good one; its defects are those which are inseparable from the attempt to get a "systematic treatise" into a small compass, its great virtue is that it is in most things sound, and forms a good introduction to the study of a great and increasingly important branch of medicine.

Stereoroentgenography. Pulmonary Tuberculosis. Kennon Dunham, M.D. By Dr. Howard A. Kelly, M.D., Baltimore. The Southworth Publishing Co., Troy, New York.

This work is illustrated by 42 stereograms which purport to illustrate the appearances of tuberculosis as it affects the thoracic viscera, particularly the lungs.

The author explains in the introductory remarks that his intention was to present the points which he considered of value in making an early diagnosis of tuberculosis, but he finally decided to put forward his own creative work on the subject, *i.e.*, tuberculosis. We could almost wish that he had adhered to his original intention, for, with his large experience, it would have been easy to indicate many points of value in the early diagnosis of tuberculosis by radiography, but in that case it would have been necessary to give the results of his experience in radioscopic examination of the thorax, and this is obviously impossible of demonstration by stereoroentgenography. He further explains that he has adopted, not created, a practical technique. We look in vain for information concerning the length of exposure, quality of ray employed, and other points of value to the radiographer.

The author states that he has "proven" the cause of the "tree-like" shadows seen upon a normal chest plate to be due to blood vessels, bronchi, and connective tissue, and not due to any one alone, and further that the connective tissue is the most important element. We are not aware that this has not for a long time been accepted as the explanation of the "tree-like" shadows.

Dr. Dunham then states that he has described the normal chest plate, and shown that characteristic variations occur in tuberculosis. He says, "This reading has been verified by over two thousand carefully examined cases, worked up in conjunction with able men in the Cincinnati Tuberculosis Sanatorium, Johns Hopkins Hospital, and Effendorf Krankenhause; also more than two hundred autopsies have been made in these cases."

All credit must be accorded to Dr. Dunham and his colleagues for this valuable piece of work, and Dr. Dunham states that in his opinion "the cause of these tuberculous changes are due to connective tissue changes."

The latter statement is open to question when we are dealing with Cause as distinct from Effect. The commonly accepted theory is that advanced by Jordan and others, that tuberculous infection is the exciting cause, and the increase of connective tissue seen in most of these cases is the result of reaction on the part of the connective and other tissues, leading to an increase in substance of the tissues and a consequent increase in density in the root shadows. Possibly Dr. Dunham means the same thing, but expresses it differently.

A good description of the method of stereoscopic radiography follows, with a full account of the appearances presented by the normal thorax; the various points to be considered are enumerated.

A short paragraph deals briefly with the differential diagnosis of tuberculous from other conditions, and the author concludes the introductory chapter with the following remarks:—

"To men who have never known the illumination of having their previously uncontested physical examinations constantly checked by the bold black and white of stereoroentgeno-

grams, the claim I make for the necessity of their use seems based upon an inability to make good physical examinations, or on an undue enthusiasm for the Roentgen ray. But constant use of the roentgenological method since 1909, both in conjunction with my own physical examinations and those of the ablest men in the world, as well as with post mortem examinations, has enabled me to state authoritatively that stereoroentgenological examination of the chest has added that scientific element to the study of tuberculosis which marks another decided advance towards the understanding and illumination of this disease."

We fail to see how Dr. Dunham can expect the "non-expert" to agree with the latter contention,—the pathology of the disease has been fully worked out long before radiography lent its aid in diagnosis. The most complete X-ray examination has only succeeded in demonstrating the presence of pathological conditions in the living in a more or less imperfect way. Only the most expert observer can interpret these findings with any degree of accuracy.

The expert clinician can ascertain as much as radiography is likely to show. Radiography does, however, provide us with a means of recording the changes in the thorax, their extent and rate of progress, and in this capacity it is of the greatest value.

The complete X-ray examination to be of value must be accompanied by a careful screen examination, then many points can be ascertained which it would require not one but many stereoroentgenograms to successfully demonstrate.

The "non-expert" reader might wander over the 42 stereos again and again with hardly any advantage to himself, as far as the early diagnosis of disease is concerned, but it is in the recognition of the early stages of thoracic disease that radiography can be most helpful, and it is in this respect that the present work is admittedly defective.

Dr. Dunham points out that the proper reduction from the plates is difficult, and even in accurate work much detail is lost. For that reason he cannot show the earliest lesions of tuberculosis in this series. An inspection of the reductions shown bears out this statement, for it is not possible in a number of the illustrations to recognise fine changes which are described in the text. From the high character of the work it is quite easy to believe that the original plates were full of fine detail which is not reproduced on the reductions. The original plates were 15 by 12 inches in size, so it is readily seen that much of the detail is necessarily lost; another contributory cause of this loss of detail lies in over printing in a number of the reproductions. Apart from these unavoidable defects the standard of the work is very high; the conviction is forced upon one that in order to get the best value from stereoroentgenography it is necessary to view the full-sized plates in the stereoscope. The description of the normal distribution of the bronchi and the experimental work done to illustrate the necessary points is particularly good, and indicates the amount of labour which has been gone through to make this section complete.

A few of the expressions used strike the reader as being unusual; thus, "norm" is obviously meant for normal, the "right and left upper" is meant to designate the corresponding parts of the upper thorax or bronchi, as the case may be, while the diaphragm is inaccurately referred to in several places as the right or left "diapragms." These are, however, small details which in no way detract from the real value of the book.

A full reference to the number of stereograms is not possible, but the general arrangement of the book will be indicated.

Class I. Experimental.—Includes a short description of the technique employed to produce the results, the arrangements of the bronchi being adequately described. The illustrations in this section are very instructive.

Class II. Tuberculous.—Lung removed from the body; the lung has been inflated. Extensive cavities are seen.

Class I. Non-tuberculous.—Normal chest with a fractured clavicle, from a healthy boy; this stereogram is used to illustrate the normal, yet it shows evidence which, under other circumstances, might warrant the suggestion of tuberculosis. It also very well illustrates the difficulty which there is in obtaining normal chest pictures.

Class II. Tuberculous.—In this section a number of cases of tuberculosis of the lungs

are shown, including tuberculous mediastinitis, early tuberculosis in a child of 12 years; this illustration strikes one as showing a condition more advanced than the description warrants. Active pulmonary tuberculosis is illustrated by a picture which, to a cursory glance, shows very little change from the normal; possibly this is one of the plates which has suffered most from reduction. Early tuberculosis, Stereo 11, is an instance where the photographic technique is somewhat at fault, one picture showing very little of the lung detail.

Tubercular pleurisy is shown in Stereo 15, occurring in a tuberculous subject. The statement is made that such a lesion is pathegnomonic of tuberculosis.

Pulmonary tuberculosis with abscess. Stereo 17.—A description is given of an abscess in the posterior mediastinum. The non-expert will have difficulty in recognising the abscess.

The portion devoted to fibroid tuberculosis is one of the most instructive sections of the work; the text is full of useful suggestions. The author rightly states that, "If roentgenologic and diagnostic methods were limited to this one variety of tuberculosis the necessary expense and laborious technique would be justified."

Stereos 18 to 26 illustrate the section, many beautiful radiograms are here shown. The value of these plates as a guide to physician in prognosis and treatment is very great.

A valuable contribution to our knowledge follows, under the heading "Therapeutic pneumothorax safeguarded by stereoroentgenograms." It is well illustrated by pictures from a case so treated, and shows the stages before, during, and after the treatment. An interesting case of healed tuberculosis and syphilis is shown, the distinctive characteristics are not described, nor does the stereoroentgenogram give any detailed indication of the dual infection; tertiary syphilitic changes are described as being present in the clavicle and left humerus. In the reduction the clavicles are visible, but the humerus on either side is lost in the general confusion of shadows.

Chronic bronchitis and emphysema are briefly dealt with, as is also arterio-sclerosis with emphysema.

Syphilis with appearance of normal chest. In this case the diagnosis must have been arrived at clinically. In the absence of X-ray evidence why publish the case? The point is made later, in the description of this, and in the observation of a number of other cases, where syphilis is the infective process, of the difficulty in differentiating between syphilis and early tuberculosis.

The publication finishes with a description of a number of cases of lung fungus, and the distinguishing points in diagnosis are enumerated; several of these are complicated by tuberculosis, so presumably the fungus invasion may be a secondary manifestation. A description of the particular fungus at work in these cases would have been interesting, as would also have been the reasons for a diagnosis of fungus invasion in contradistinction to tubercle.

This work is quite up to the average of the series. The general details leave little room for improvement, with the exception of the slight defects already referred to.

The book should prove useful to physicians and radiologists in their daily work, and is of particular value to the expert who wishes to be conversant with the latest developments of his art, and it will add greatly to the knowledge of all who carefully study the successive sections.

NOTES AND ABSTRACTS.

INSTRUMENTAL.

Experiments with Mercury Jet Interrupters. *Proceedings of Physical Society*, London, August 15th, 1916. By C. E. S. Phillips.—The paper describes an experimental attempt to ascertain the form of the mercury column issuing from a hole in the side of a rotating drum that is continuously supplied with mercury by centrifugal action.

Incidentally a new form of interrupter is introduced, in which the interior is visible

through a window in the lid. The arrangement forms a suitable apparatus for experiments with various forms of orifices and metallic contact segments, and the paper gives an account of work in that direction. As it is important to ensure the cleanliness of the mercury in interrupters of this type, the usual copper segments are replaced by ones made of tantalum, which, for many reasons is preferable. It is not "wetted" by mercury, it remains clean and bright indefinitely, and its high melting point renders it lasting.

Experiments with various forms of orifice are described, and it is pointed out that the issuing stream is only slightly affected by this means. An explanation is given of the fact that a vertical slit orifice will not produce a ribbon of mercury, and that no matter how much the diameter of the orifice is increased beyond about 2 mm., the cross section of the mercury column remains unaltered. A method is described, however, by which a much larger stream of mercury can be obtained from the rotating drum, if necessary.

Brief reference is made to experiments with various volatile liquids in suppressing the flare which occurs when the mercury columns leave the contact segments. The three well-known substances which are most effective in this respect are coal gas, hydrogen and ether.

These experiments are of especial significance in pointing out the various ways in which improvements may yet be effected in such a vital part of X-ray apparatus as the interrupter.

CORRESPONDENCE.

To the Editors of ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY.

13th General Hospital,
B.E.F.

DEAR SIR,

I have used intensifying screens since their manufacture, and lately I have been struck with the fact that I do not obtain the same results as formerly. I should be very pleased to know the opinions of others upon the subject.

The screens supplied are "The London Screen," and I understand that they are supposed to reduce the normal exposure to one-tenth of its value.

The following tests were made recently by me upon a knee-joint, a tungsten target tube in a condition of 6 Benoist being used, and inverse current being entirely absent.

First, it was found that the correct exposure of the knee in question was 8 seconds with 5 milliamps. Next, it was considered necessary only to allow $1\frac{1}{2}$ milliamps. through the tube when using the intensifying screen. Consequently, it was calculated that an exposure of 27 secs. should be given without the use of the screen. Further, a series of plates were taken (1) with the X rays passing through the back of the screen on to the film of the plate (2) with the rays passing through the back of the plate through the film to the front of the screen. (3) Both (1) and (2) were repeated, using photographic plates instead of X-ray plates.

The following were the conclusions drawn from an examination of the radiographs:—

(1) Better results were obtained with the rays passing through the back of the plate than with them passing through the back of the screen.

(2) Photographic plates are better than X-ray plates for use with the screen.

(3) The plates require an exposure of at least one-quarter of that required without the use of the screen.

The plates were developed in a solution made according to a modified Ilford formula. They were all developed at the same time and given the same period of development, viz., 15 minutes.

Yours truly,

H. E. GAMLEN,
Capt. R.A.M.C.

PUBLICATIONS RECEIVED.

Book.

The Emission of Electricity from Hot Bodies. By O. W. Richardson, F.R.S. Longmans Green & Co.

Journals.

American Journal of Electrotherapeutics and Radiology, Nov., 1916.

American Journal of Roentgenology, Nov., 1916.

Archives d'Electricité Médicale et de Physiotherapie, Dec., 1916.

Boston Medical and Surgical Journal, Nov. 23rd, 30th, Dec. 7th and 14th, 1916.

Bulletin of the Johns Hopkins Hospital, Dec., 1916.

Cleveland Medical Journal, Oct., 1916.

Gaceta Médica Catalana, Nov. 30th, Dec. 15th, 1916.

Good Health, Dec., 1916.

Interstate Medical Journal, Nov., 1916.

Journal of the National Dental Association, Nov. 1916.

Maryland Medical Journal, Dec., 1916.

Medical Journal of Australia, Oct. 21st, 28th, Nov. 4th, 11th, 1916.

Medical Record, Nov. 18th, 25th, Dec. 2nd, 9th, 1916.

Medical Times, Dec., 1916.

New York Medical Journal, Nov. 18th, 25th, Dec. 2nd, 9th, 1916.

New York State Journal of Medicine, Nov., 1916.

New Zealand Medical Journal, Oct., 1916.

Norsk Magazin for Lægevidenskaben, Dec., 1916.

Policlinico, Il, Dec. 1st, 1916.

Proceedings of the Royal Society of Medicine, Nov., 1916.

Southern Medical Journal, Dec., 1916.

Ugeskrift for Læger, Nov. 16th, 23rd, 30th, 1916.

Urologic and Cutaneous Review, Nov. and Dec., 1916.

NOTICES.

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Vol. XXI—No. 9 FEBRUARY, 1917 No. 199

ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

SOME AIDS TO ACCURACY AND RAPIDITY IN X-RAY LOCALISATION.

By Capt. Walter Oram, R.A.M.C.T., M.D., B.Ch., B.A.O., D.P.H., B.A.,
Trinity College, Dublin.
Hon. Radiographer, Northern Hospital, Stanley Hospital, Liverpool, and Southport Infirmary.

Localisation by the screen method is always a more or less dangerous process for the radiographer, and any suggestions which may lead to a saving of time or to increased accuracy, may not be out of place at the present time, when the attention of all X-ray workers is attracted to the matter.

The method I have used exclusively is that described by Dr. Hampson in the Archives of the Roentgen Ray for November, 1914, and to those who use this method the following notes may be of interest :—

Outline of the Process of Localisation.

The patient lies upon the screening couch, which has beneath it a tube box on wheels, which can be moved along and across the couch. This box must be furnished with an adjustable square diaphragm, and should be provided with some efficient mechanism for centreing the tube beneath it.

The fluorescent screen is placed above the patient, and the foreign body having been found, the diaphragm is almost closed, so that a perpendicular ray is obtained. The position of the shadow of the foreign body is then marked upon the screen, and the patient's skin is marked under the screen at the same spot.

The foreign body is known to lie directly under this point, and its depth in the tissues can be ascertained as follows:—Without moving the patient or the screen, shift the tube box exactly 10 cms. towards the patient's head, opening the diaphragm to a slit parallel to the sides of the couch. The shadow of the foreign body will traverse the screen a certain distance in the opposite direction, and take up a new position, and the distance which separates the two positions of the shadow can be measured in centimetres. This distance is known as the traverse of the shadow, and Dr. Hampson shows that, knowing the traverse and the distance which the anticathode of the tube lies from the screen, it is possible to calculate the depth at which the foreign body lies in the tissues, by means of a simple formula or a prepared scale. One is then able to say that the foreign body lies directly beneath a spot upon the skin which has been marked and at a definite depth in the tissues, and that the body has been completely localised.

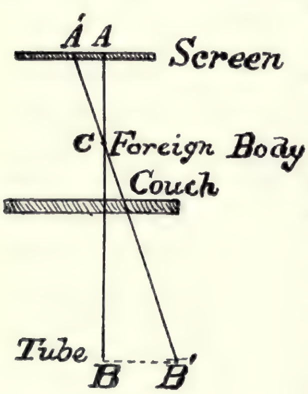


Fig. 1

The depth of the foreign body can be determined by the following formula (see Fig. 1):—

$$\text{Depth in tissues (A C)} = \frac{\text{Traverse of shadow (A A}') \times \text{Tube to screen distance (B A)}}{\text{Traverse of shadow (A A}') + \text{Shift of Tube (B B}')}$$

The Use of a Small Screen.

The large screens usually employed in every-day X-ray work are not convenient for localisation, on account of their weight, size, the difficulty of bringing them into contact with the body in certain regions, and of marking the skin accurately beneath them. The small screen described by Capt. Thurstan Holland in the Archives of the Roentgen Ray for December, 1914 (see Fig. 2), surrounded by protective rubber sheeting, with a small hole drilled through the glass and the screen, through which the skin can be marked, is a great advantage.

Fixed to the side of this screen is a pointer which can be moved along a graduated scale and is clearly visible when the screen is in use. The

graduations read from the hole in the screen, which acts as a zero, and the traverse of the shadow when the tube is moved can thus be easily registered, and afterwards read off on the scale.

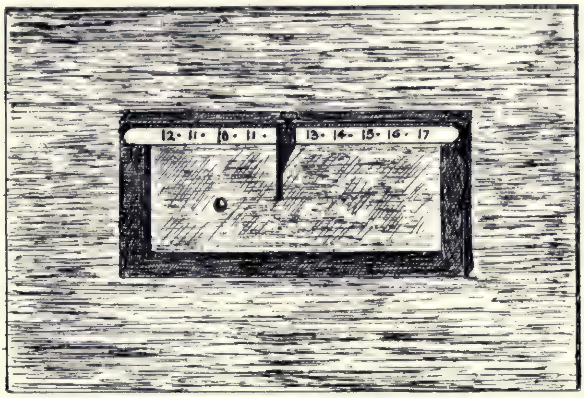


Fig. 2.—Captain Holland's Screen.

Detailed Description of the Process of Localisation.

The process of localisation by this method divides itself into the following seven stages :—

(1) The centreing of the tube.
(2) The finding of the foreign body.
(3) The marking of the skin with the small perforated screen.
(4) The shifting of the tube through 10 cms.
(5) The measurement of the movement or traverse of the shadow produced by this displacement of the tube.
(6) The measurement of the distance from the anticathode of the tube to the screen.
(7) The determination of the depth of the foreign body from these details.

The Centreing of the Tube.—That is its adjustment exactly under the middle of the diaphragm, so that an absolutely vertical ray is obtained when the diaphragm is almost closed.

Many couches are not provided with any means of centreing the tube under the diaphragm, and in some where such is provided, the adjustment is not accurate. Some means of detecting and correcting an error in centreing is therefore desirable, and I have found the instrument now described convenient for the purpose.

It consists of a wooden box exactly ten centimetres in height, open at the top and closed below by a sheet of parchment (see Fig. 3).

This box has two platforms attached to it. The lower one is lead lined and acts as a protection to the operator during use, the upper one is flush with the top of the box. The box is intended for use with Captain Holland's small screen, and two studs (B) projecting from the top of the upper platform

fit into holes drilled in the under side of the frame of the screen, and when so placed, the hole in the screen lies vertically over the centre of a fine metal wire (A) stretched across the parchment bottom of the box. The centre of this wire is marked by a metal bead.

In use, the centreing box with the screen attached, as shown in the diagram, is laid upon the couch, and its lower parchment covered surface and the wire above it will then be in contact with the surface of the couch. If a couch with a canvas top is used, a light board should be placed across it from side to side so that the apparatus may stand vertical. The longer side

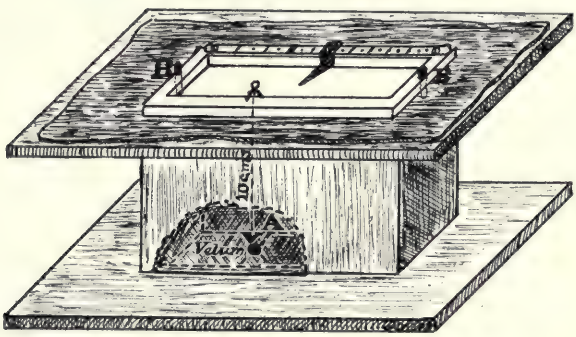


Fig. 3.—Screen fitted in position on centreing box.

of the box must be parallel to the side of the couch. The tube having been set in action, the tube box is now brought beneath the instrument, with an open diaphragm, and moved about until the shadow of the bead on the wire at the lower end of the box, exactly coincides with the hole in the screen. The diaphragm is slowly closed, and should the illuminated area narrow down exactly upon the hole in the screen the tube is centred. If it does not do so, the centreing of the tube requires adjustment, and the distance either to the right or the left of the zero hole to which the illuminated area narrows down, can be ascertained by the use of the pointer and scale.

To take an example: Let us say that the diaphragm closes down 2 cms. to the right of the zero. It is now necessary to know what movement of the tube beneath the diaphragm will be required in order to correct the error. To determine this, open the diaphragm until it measures exactly 1 cm. across. This can be done by passing a cylinder of wood 1 cm. in diameter, attached to a handle (see Fig. 4), into the jaws of the diaphragm, and closing them down until it is gripped. Now observe the length in cms. of the illuminated area upon the screen given by this diaphragm. Let us say that it is 2·5 cms. Divide this number into the distance (2 cms. in this case) that the centreing of the diaphragm as observed upon the screen appeared to be in error. The quotient, ·8 cms., will be the distance the tube must be moved in its holder, underneath the diaphragm to bring it into exact

**Fig. 4.—A. Handle.
B. Cylinder, 1 cm. in diameter.**

centre.* The tube must be moved towards the right in its holder if the diaphragm, as in this case, closes down to the right of the zero. If the centreing in the line from side to side of the couch is defective, it will be indicated by the diaphragm when closed down in both directions, giving a point of light which lies either on the near or the far side of the hole in the screen, instead of being to its right or left. To determine how much the tube is out of centre in this direction, the centreing box should be turned round to lie across the couch, and the process above described repeated. An error in this direction is not as a rule so easily remedied, and frequently entails the cutting of the jaws of the clamp that holds the tube, and it is obviously important to know how much the jaws must be cut.

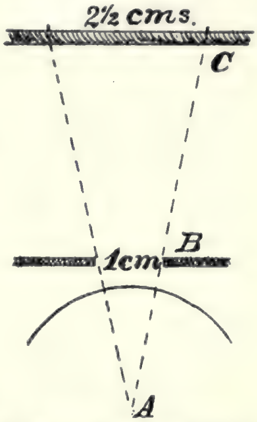


Fig. 5.—A. Anticathode. B Diaphragm. C. Screen.

The Finding of the Foreign Body.—This is best carried out with the large screen, as a wider field of vision is thus obtained. When the foreign body has been found, one has to decide whether the localisation should be carried out from the back, the front, or from either side in the case of a limb, and this will usually depend upon the skin surface to which the foreign body lies closest. This point can often be decided by turning the limb about its long axis, or where this is not possible, by moving the tube from side to side and noting the movement of the shadow; considerable movement with a slight shift of the tube, suggesting that the patient should be turned over and the localisation performed from the other side. When it has been decided from which direction localisation is to take place, careful notes should be given for the information of the surgeon, so that during the operation the same position of the limb may be reproduced, and stereotyped positions should as far as possible be employed.

Having decided the direction from which the localisation is best carried out, and placed the patient in a suitable position, the diaphragm of the tube should be slowly closed down, keeping the foreign body in the centre—by moving the tube beneath the table—until eventually its shadow is made to lie in the centre of an illuminated area about one inch square.

Fig. 6—Cane Skin Marker.

The Marking of the Skin.—The large screen is now removed and the small screen placed upon the patient's skin, and moved about until the shadow of the foreign body, or some definite part of it (say the point, if it be a bullet,) falls upon the hole in the screen.

* Since the shadow of the 1 cm. diaphragm upon the screen is 2½ times as large as the diaphragm itself (see Fig. 5), we know that the screen is 2½ times as far away from the tube, and in consequence any rror in centreing of the diaphragm will be magnified to that extent upon the screen. If therefore the error in centreing observed upon the screen be divided by 2½, we arrive at the amount which the iaphragm is out of the centre.

The screen must lie parallel to the top of the couch and the hole must be in contact with the skin, and to fulfil these conditions it is often necessary to place a wad of lint under the end of the screen remote from the zero. One now knows that the foreign body lies vertically under the hole in the screen, and a thin piece of cane tipped with rubber (see Fig. 6), and inked, by pressing on a date stamping pad, can be passed through the hole and will leave a clear and neat mark upon the skin directly over the foreign body. This cane may be graduated in centimetres and will then serve for measuring the distance from the screen to the skin when the two cannot be brought in contact, as for example in the axilla. This distance must, of course, be deducted from the depth of the foreign body when found.

When the skin has been marked, the diaphragm should be opened to a slit in the direction of the long axis of the couch.

The Shifting of the Tube through Ten Centimetres.—This can be easily done in many ways—but I have found a pedal attached to the runner of the tube

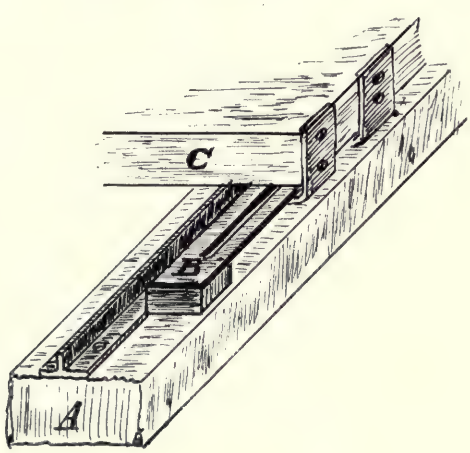


**Fig. 7.—A. Rail of Couch.
B. Pedal.
C. Runner of tube box.**

box (see Fig. 7) very convenient because it ensures accuracy and can be operated in the dark by the use of one hand.

The pedal is constructed of a stout strip of brass which slides in guides underneath the runner of the tube box. A slot is cut in this strip into which a stud, driven into the under surface of the runner, fits, and a motion backwards and forwards of the pedal of exactly 10 cms. is thus permitted.

The pedal, when pushed home, projects two or three inches from the side of the runner, and has on its under-side a thick piece of rubber, which stands directly over, and just clear of, the rail of the couch. Before beginning the localising process the pedal is pushed in, and when one desires to make the displacement of the tube one's foot is placed upon it, and it is thus brought down upon the rail and held. The box can now be moved away by the hand, and the stud will allow it to move 10 cms. and no more.

The Measurement of the Motion of the Shadow.—The tube having been displaced 10 cms. it will be found, on looking at the screen, that the shadow of the foreign body has moved along the illuminated slit and taken up a new position.

The pointer of the screen is to be moved to mark this new position and the displacement can then be read off upon the scale.

The Measurement of the Distance from the Anticathode of the Tube to the Screen.—The determination of this distance cannot be made directly as it consists of three definite parts:—

(*a*) From the anticathode to the glass of the tube.

(*b*) From the glass of the tube to the surface of the couch.

(*c*) From the couch to the screen.

But by means of the centreing box I have described, it is possible to make a determination of the sum of the first two, viz., the distance from the anticathode to the surface of the couch, and when this is known, a tape measure can be adjusted, as will be described later, so that the tube to screen distance can be read off directly by a single observation.

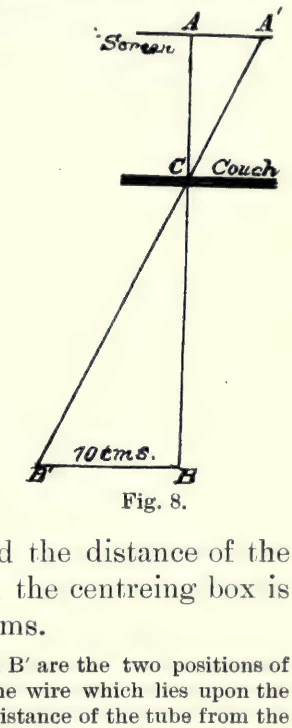


Fig. 8.

The centreing box may be used, after the tube has been centred, to determine the distance which the anticathode of the tube lies beneath the couch, in the following manner. Place the centreing box with screen attached, upon the couch with its scale parallel to the side of the couch as before, and bring the active tube beneath it until the shadow of the wire falls on the hole in the screen. Now move the tube 10 cms. by means of the pedal, and the shadow of the wire will move and its displacement can be determined by the pointer and scale. Let us say that this displacement is 5 cms. Divide this number into the number 100 and the distance of the anticathode below the couch, or the board upon which the centreing box is standing, will be obtained. In this case it is $_{5}$, *i.e.*, 20 cms.

The reason for this will be evident from the diagram (Fig. 8). B and B′ are the two positions of the tube 10 cms. apart. A and A′ are the two positions of the shadow of the wire which lies upon the couch at C. The distance AC is the height of the box (10 cms). BC is the distance of the tube from the couch which one requires to find.

$$\frac{BC}{BB'} = \frac{AC}{AA'} \text{ or } BC = \frac{AC \times BB'}{AA'} \text{ or } BC = \frac{10 \times 10}{AA'} = \frac{100}{AA'}$$

Knowing the distance from the anticathode to the top of the couch, a tape measure may be used, as follows, to read off the tube to screen distance.

A linen tape centimetre measure is fixed to the overhead arm, which is provided on most couches and travels with the tube (see Fig. 9). This measure should be so arranged that when drawn down to the table, the graduations read from above downwards, the smaller numbers being at the top, and it should be of such a length that when its terminal ring is in contact with the couch, the last number visible at the opening of the case of the measure is the

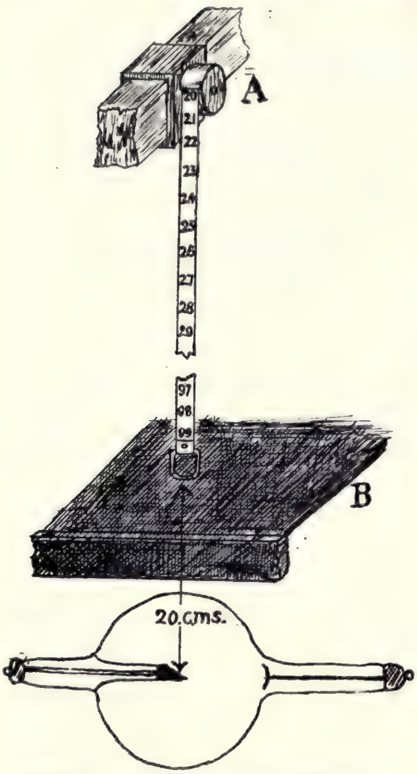


Fig. 9.—A. Tape measure fixed to overhead arm.
B. Surface of Couch.

same as the distance in cms. from the surface of the couch to the tube. It is evident that as such a measure is allowed to rewind itself, the last number visible will always give the distance of the ring on the end of the measure from the anticathode, and if the ring is drawn down at any future time to the surface of the screen in position on the patient's skin, the distance of the screen from the anticathode will at once be determined by taking the reading of the tape at the opening of the case.

The Determination of the Depth of the Foreign Body.—We are now in possession of all the details necessary for calculating the depth of the foreign body. We know the traverse of the shadow when the tube is moved 10 cms., and we have found the tube to screen distance, and by applying the formula already given we arrive at the depth. This is, however, a tedious calculation, and it can be avoided by many simple methods. Captain Holland uses a set of prepared tables by which the depth is given at once. Capt. Barclay has invented an ingenious apparatus which serves a like purpose, and various workers have suggested other methods. I have found a prepared chart of use for this purpose (see Fig. 10), and while I do not know that I can claim that it is any more simple or effective than other methods, I have found it rapid in calculation.

A graduated wooden scale at the top of the chart represents the various possible tube to screen distances, and a slider on this scale carries a light cord, which passes through a hole exactly over the zero in the left hand bottom corner, and is kept taut by a small weight.

To use the chart this slider is brought to the determined tube to screen distance—the number of cms. representing the determined traverse of the shadow is found along the scale on the left hand margin, and the horizontal line through this is followed until it is cut by the cord. The number so obtained will be the depth of the foreign body in the tissues in cms. Thus, if the tube to screen distance be 37 cms., and the traverse 2·5 cms., it will be seen that the depth in the tissues is $7\frac{1}{2}$ cms., or a trifle under. Calculation gives the correct distance as 7·4 cms.

The dimensions of the chart are about four times those of this illustration, and it is covered by a sheet of glass. It is possible to determine the depth to the nearest millimetre by its use, if one wishes to be so accurate.

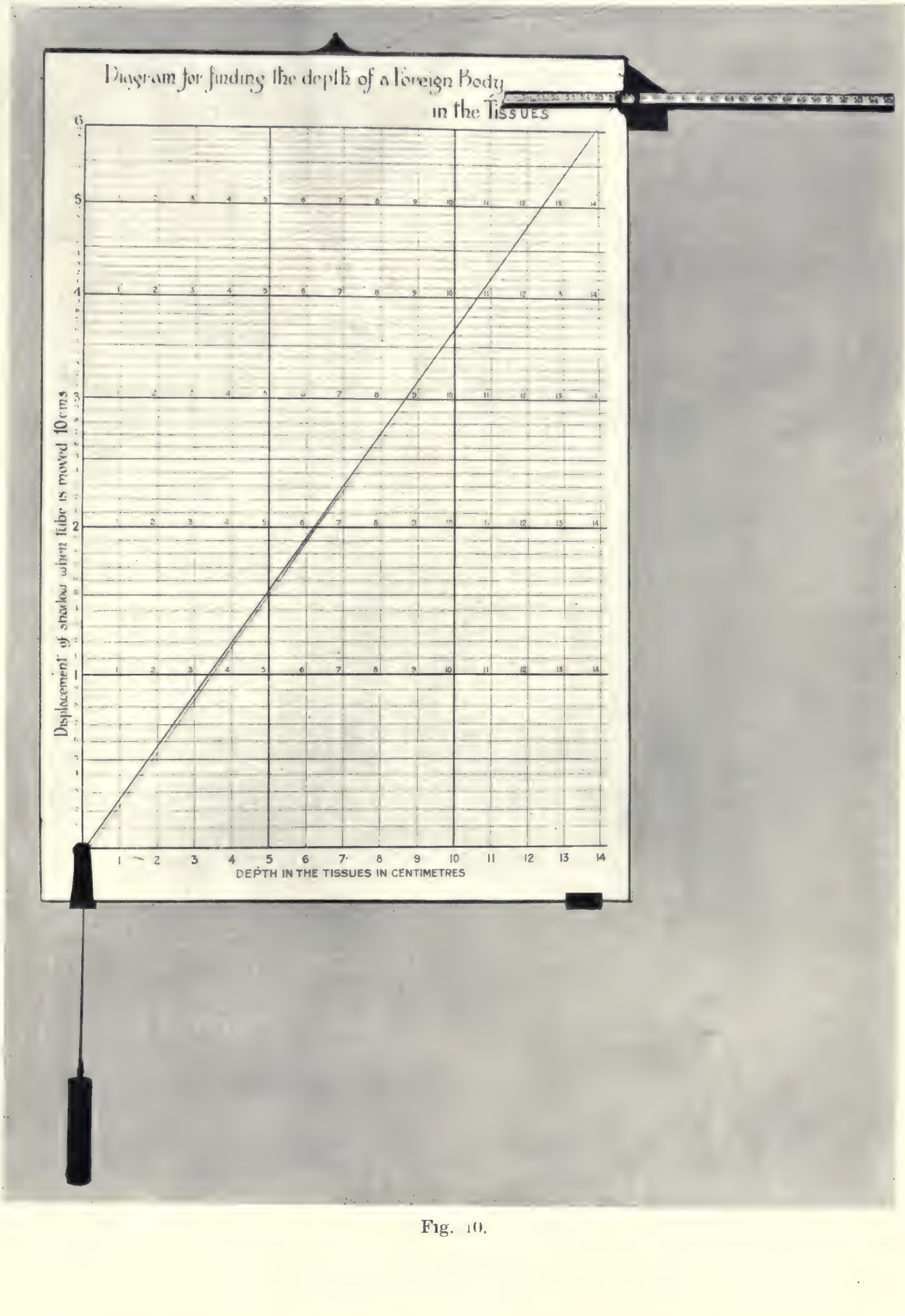


Diagram for finding the depth of a Foreign Body
in the Tissues
Displacement of shadow when tube is moved 10 cms
DEPTH IN THE TISSUES IN CENTIMETRES

Fig. 10.

CASE OF MULTIPLE EXOSTOSES AND ABNORMALITIES OF THE OSSEOUS SYSTEM OCCURRING IN A SOLDIER ON ACTIVE SERVICE IN FRANCE.

By J. McKail, M.A., M.B., Late Lieut. R.A.M.C., and Officer-in-Charge, X-ray Dept., 10 Stationary Hospital, B.E.F.

The following case appears to me to be of sufficient interest to justify publication. Pte. C——, A.S.C., M.T., 27 years of age, and 18 months service in the Army as motor-driver, was admitted to 10 Stationary Hospital on March 8th, 1916, complaining of pain in the left ankle and some difficulty in walking, on account of which he was unable to carry out the prescribed drills and route marches.

On examination there could be made out just above the internal malleolus of the left ankle a small hard fixed swelling the size and shape of a hazel nut, pressure on which by the service boot had been the cause of the complaint. This swelling had been there as long as he could remember, and he also mentioned that he used to have a larger swelling on the outer side of the same leg, which, however, had disappeared by the time he reached puberty.

On the front of the chest, two inches above the left nipple, another lump presented itself, while immediately below the angle of the left scapula was a group of them. All appeared to be attached to the underlying ribs, and the skin was freely movable over them.

The forearms presented a decidedly peculiar appearance, being curved outwards and having the muscles bunched as it were over the curves, so that the arms appeared to be powerfully developed.

The left leg was slightly shorter than the right, giving rise to an almost imperceptible limp, and the left forearm shorter than the right. The right knee was weaker than the left.

Except for children's ailments he had always had good health, and enjoyed the full use of his limbs. He remembers being taken as a child to a Children's Hospital on two occasions, owing apparently to some deformity or weakness of the limbs, but more for advice than treatment.

In civil life he was an engineer by trade, having a small business of his own in London, and always being able to do a hard day's work. From one or two minor inventions of his own he enjoyed a small royalty. He was of medium height, with fair hair, florid complexion, and rather prominent light blue eyes.

He thought his father had a lump on his left knee and walked with a slight limp. His eldest brother had a swelling on one finger, while another


Fig. 1.


Fig. 2.


Fig. 3.

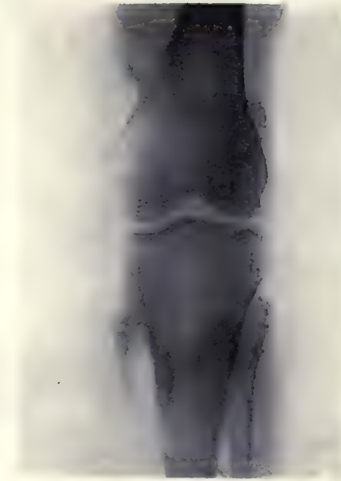


Fig. 4.


Fig. 5.


Fig. 6. (a)—Antero-posterior View


Fig. 6 (b)—Lateral View.


Fig. 7

PLATE 24

had an arm shaped similarly to his own. His elder sister suffers from Graves' disease.

At the request of the medical Officer-in-Charge, the left ankle was screened and then radiographed.

X-ray Examination.

This resulted in the discovery of the cause of the disability, and led to the locating of other abnormalities. These are shown in the accompanying illustrations. Of the whole series the most striking are the right forearm and knee.

In the former (Fig. 1) the outward curvature of the radius is very pronounced, and is probably compensatory. The ulna shows congenital

Fig. 8.

deficiency at its lower end, near which is a prominent spur. In the left forearm (Fig. 2) the curvature is not so marked, nor is the ulna quite so short. The 4th and 5th metacarpals of the right hand (Fig. 3) are shortened and show small excrescences on their shafts. A similar condition was present in the left hand.

Right knee (Fig. 4) : A remarkably long bony spike, bifid at its extremity, juts downwards from the head of the tibia, whence it arises, parallel to the shaft of the bone for a couple of inches. The head of the fibula is thickened and shows an outgrowth, having a frilled appearance below. In the substance of these two bones there is a striking appearance which is difficult to explain on pathological grounds.

At the lower end of the femur, just above the adductor tubercle, there is a horn-like projection.

Left knee (Fig. 5) : As with the forearms the left is not quite so striking in appearance.

The left ankle (Fig. 6) is marked by the rounded tubercle, which gave origin to the clinical symptoms. The lower end of the fibula has a curious appearance. There is evidently fusion between the lower ends of the bones, but here also the explanation is rather difficult.

The foot (Fig. 7) needs no remark. In the right shoulder and chest (Fig. 8) we find bossing and irregularity of the humerus. The knob-like swellings previously mentioned on the chest wall may be made out.

The most obvious features of the pelvis are the straightening out of the neck of the femur and the alteration in the shape of the great trochanter (Fig. 9).

Fig. 9.

The skull had a marked prominence at the occipital protuberance.

In passing, one may be permitted to point out (1) that multiple exostoses are formed of cancellous tissue ; (2) they are as a rule covered with a cap of cartilage, and (3) they cease growing when the skeleton reaches maturity.

As regards their ætiology, there is a distinct hereditary factor ; and they are supposed to be due to displaced areas of cartilage cells. It has been suggested that rickets is a factor in the causation.

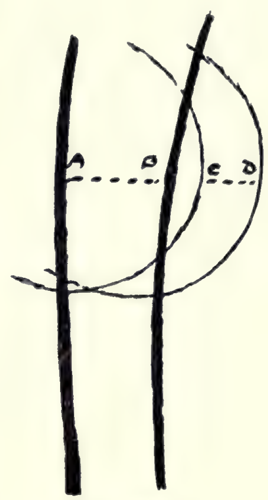
The case is interesting because of the multiplicity of the exostoses and their associated features ; and from the fact that their presence gave rise to no inconvenience to the patient except the disability complained of, and was indeed unsuspected by him till revealed by the X rays.

THE USE OF LOCALIZATION METHODS IN THE ELUCIDATION OF DOUBTFUL SHADOWS IN THE KIDNEY REGION.

By F. Hernaman-Johnson, M.D., Consulting Radiologist, Aldershot Command, etc.

In the early days of the war I pointed out, in a letter to the Archives, that methods devised for the exact measurement of the depth of projectiles might prove useful in ordinary clinical work, such as the diagnosis of gall stones, renal calculi, etc.

"Double Image" Radiograph of case in which a large circular shadow had been seen in renal regions. Note double image of
1.—Opaque bougie. 2.—Edge of circular shadow.
3.—Edge of bodies of vertebræ.



Key Diagram.
A. B.—Traverse of shadow of bougie.
C. D.—Traverse of shadow of concretion.
Note that A. B. is nearly double C. D.

It is, of course, well known that unless shape, appearance and position are very characteristic, it is unsafe to assert the exact clinical significance of any abdominal shadow, however marked and persistent it may be. A measurement of depth will often discriminate between gall stone shadows and those

of calculi in the right kidney, and between kidney stone and concretions in the mesentery, etc.

The particular method with which I am familiar is that carried out by a ring localizer and the mechanical wall diagram which I devised; but other allied procedures are equally applicable.

I append a "double-image" radiograph of a case which was sent for suspected stone. A previous skiagram had shown a large round shadow in the region of the pelvis. A few years ago such a case would have been operated on forthwith.

Further investigation was made as follows :—

A ureteral bougie was passed by the surgeon. Both this and the shadow could be seen clearly on the screen, and the tube was manœuvred vertically beneath the shadows. An exposure was made, and, after the maximum possible tube-shift of $7\frac{1}{2}$ inches, a second image was obtained. In the original negative—and, I hope, in the reproduction—double images are clearly visible of :—

(1) The opaque bougie;
(2) The stone (?) shadow;
(3) The edges of the bodies of the vertebræ.

When the relative depths were worked out on the wall diagram, it was found that the bougie lay $1\frac{1}{2}$ inches further from the anterior surface of the abdomen than did the opaque mass causing the suspicious shadow. This was considered conclusive evidence that the mass was not intrarenal. The surgical conclusion was that it represented a concretion in the mesentery.

In this particular case, the fact that the bougie can be seen passing upwards through the shadow is of course in itself sufficient to exclude *pelvic* stone. In many instances, however, the radiograph of a bougie *in situ* gives no further information, owing to super-imposition of shadows.

The shadow which it is desired to investigate cannot always be picked out on the screen; in such a case it is sufficient to centre the tube below the usual kidney area, or as nearly beneath the shadow as adjacent landmarks in the original plate may suggest. A slight angular deviation causes an error of not more than a few millimetres when working out the depth.

DESCRIPTION OF TWO RADIUM APPLICATORS FOR MALIGNANT DISEASE OF THE MOUTH AND PHARYNX.

By Charles H. Bubb, L.D.S. (Eng.).
Hon. Dental Surgeon, King George's Hospital.

Case I.—*Endothelioma of Soft Palate.*

Fig. 1, A, B, is an illustration of the appliance used. It consists of a vulcanite plate with an extension carried backwards corresponding to the area of the growth, but not in contact with its surface, a space of $\frac{3}{16}$ inch intervening. On the palatal or upper surface of this vulcanite extension are fashioned a series of antero-posterior and lateral grooves. The grooves are lined with lead and

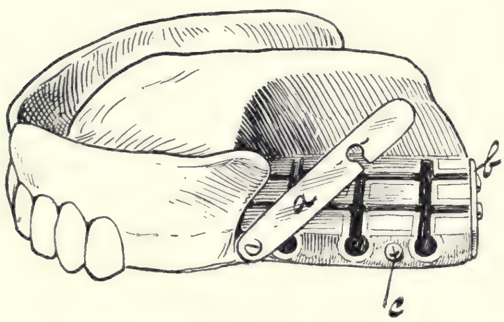


Fig. 1. (A)—Palatal Surface, Lateral View.

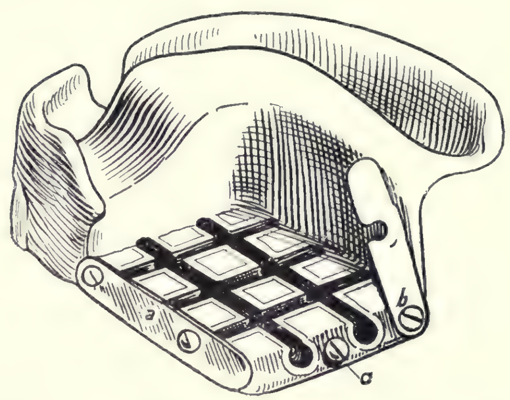


Fig. 1. (B)—Palatal Surface, Postero-lateral View.

serve to accommodate one or more tubes of radium. The tubes are prevented from slipping by two metal flanges, *a*, *b*, working on a swivel at one end and notched at the other end to allow the flange, in the closed position, to embrace a screw, *c*, inserted into the vulcanite. This screw can be tightened when necessary. By this means the radium tubes are securely retained in a known position. The lead lining of the grooves effectually screens surrounding tissues and allows the action of the emanations to be localised to any desired area of the growth.

Case II.—*Recurrent Epithelioma of the Pharynx.*

In this case a skeletal appliance was adopted as the patient had a solitary canine tooth standing in the upper jaw. The apparatus is shown in Fig. 2, A, B, and consists of a shell crown, *a*, divided on its buccal surface, to which is attached a screw and threaded bolt so that a firm grip can always be maintained on the tooth. From this gold crown an oval wire extends backwards to give attachment to a vulcanite block, corresponding roughly in size to the area of the growth. This block is lined with lead on its palatal and

pharyngeal surfaces and permits the insertion of a lozenge-shaped radium tube as well as a circular one. The method of fixation is similar to that described in the preceding case.

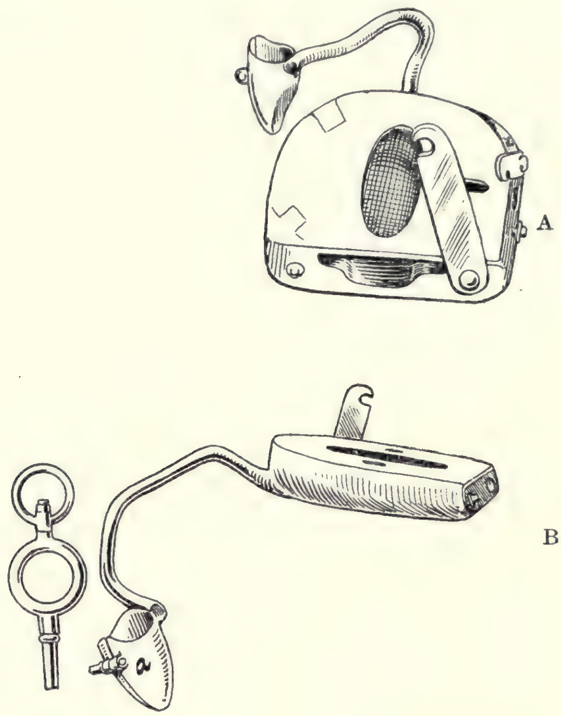


Fig. 2.—A. Palatal Surface.
B. Profile view of Aparatus with key.

[The applicators described above were made for me by Mr. Bubb for the treatment of two cases of malignant disease in the mouth and pharynx. The treatment of the cases was rendered easy by the use of these applicators. It is obvious that these forms are capable of modification to suit almost any form of tumour situated in the oral cavity.—R. K.]

REPORT OF SOCIETY.

ROYAL SOCIETY OF MEDICINE, MARCH 17, 1916.

DISCUSSION ON EXPERIMENTS AND EXPERIENCES WITH THE COOLIDGE TUBE.

Opened by ROBERT KNOX, M.D.

(Continued from page 271).

EXPERIMENT B.—RADIATION THROUGH AIR WITH A FIXED AND A ROTATING TUBE, FILTERED AND UNFILTERED RAYS BEING EMPLOYED.

The results obtained are shown in the charts.

	FIXED TUBE		ROTATING TUBE	
	No filter	3 mm. filter	No filter	3 mm. filter
Skin	43	29	5	6
1	29	23	7	7
2	24	20	9	14
3	19	19	27	32
Focus	17	18	65	73
	Five exposures of 3 min.; 15 min. in all	Three exposures of 10 min.; 30 min. in all	Eight exposures of 14 min.; 112 min. in all	Eight exposures of 30 min.; 240 min. in all

Sixteen-inch coil; Coolidge tube; amperes, 4; milliamperes, 4; heat, 4; spark-gap, 9. Proportion of skin dose to focus dose: filtered, 2 to 1; unfiltered, 3 to 1.

Coolidge tube and transformer: amperes, 17; milliamperes, 6; spark-gap, 7. Filtered greater than unfiltered. Proportion of skin dose to focus dose about 1 to 12.

CHART TO ILLUSTRATE EXPERIMENT B.

RADIATION THROUGH AIR.

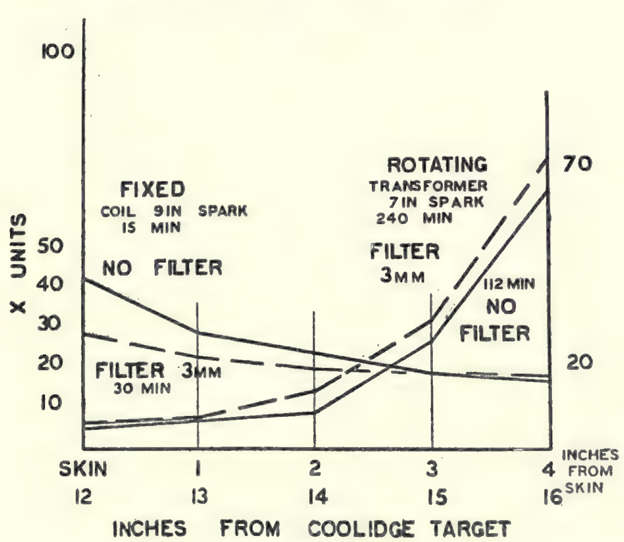


FIG. 31.

Details of Experiment: Radiations through 4 in. of Beef, the Rotating Tube being used and the Rays Unfiltered; and Filtered through 3 mm. Aluminium.

	No Filter: Soft	No Filter: Medium hard	Hard with filter
Skin	5	15	5
1 in.	1	7	1
2 in.	—	5	—
3 in.	5	15	12
4 in. (focus)	6	20	10
	Two hours		
	A	B	C

Rotating tube: no filter, two hours run, 15-in. coil, Coolidge tube, mercury interrupter; through beef, 12 in. to 13 in., and 14 in. to 15 in., and 16 in. from target.
Soft tube: amperes, 4·5; milliamperes, 4; heat, 3·8; spark, 6.
Medium hard tube: amperes, 5; milliamperes, 4·5; heat, 3·3; spark, 8.

This experiment is not charted separately, but is given on several of the other tables.

Tabulated List of a Number of Experiments with Fixed and Rotating Tubes.
Filtered and unfiltered radiations through 4 in. of beef.

Type of Apparatus	Tube fixed or rotating	No filter or 3 mm filter	Spark in inches	Distance of target to skin and focus	Minutes duration of experiment	Dose on skin	Dose on focus	Minutes to produce 1 X on skin	Minutes to produce 1 X on focus
Coil	*Fixed*	N.F.	9	10in. 14in.	60	240	7	0·25	8·5
„	„	3 mm.	9	„ „	50	*100*	*5*	0·5	10·0
„	*Rotating*	N.F.	8	12in. 16in.	120	15	20	8·0	6·0
„	„	3 mm.	8	„ „	120	5	10	24·0	12·0
Transform....	Fixed	N.F.	6	„ „	132	220	1	0·6	132·0
„	„	3 mm.	6	„ „	180	120	1	1·5	180·0
Coil	Rotating	N.F.	6	„ „	120	5	6	24·0	20·0
„	Fixed	N.F.	6	„ „	95	161	5	0·59	19·0
„	„	3 mm.	6	„ „	130	118	5	1·1	26·0

Experiment C.—Comparison of the percentage of rays passing through air and beef with a fixed tube, with filtered and unfiltered rays. The effect of the filter so far as the penetrative power of the ray is concerned was practically negligible. It appears to effect the purpose for which it is used: it cuts down the skin dose. Through 4 in. of beef the time taken to obtain 5 X was 95 min. with the unfiltered ray, while with the filtered ray it took 130 min. to obtain the same value. The dose on the skin paper, however, was 118 as against 161. In the experiments through air with the filtered and unfiltered rays the time taken to produce much more intense effects was much less, but it took twice as long to produce the same result at 4 in. with the filtered rays, the skin dose with the filtered ray being much less.

Comparative Results of Filtered and Unfiltered Rays from the Fixed Tube through Beef and Air.

Fixed tube, Beef and Air—no filter; 3 mm. filter; 12 *in.*, 13 *in.*, 14 *in.*, 15 *in.*, 16 *in.*

	Beef: No filter	Beef: 3 mm. filter	Air: No filter	Air: 3 mm. filter
Skin	161	118	48	29
1	50	38	29	23
2	22	20	24	20
3	10	8	19	19
Focus	5	5	17	18
	95 min.	130 min.	15 min.	30 min.

Amperes, 4·5; milliamperes, 4; heat, 3·8; spark, 6. Amperes, 4; milliamperes, 4; heat, 4; spark, 9.

CHART TO SHOW RESULTS OBTAINED WITH RADIATION THROUGH AIR AND BEEF.

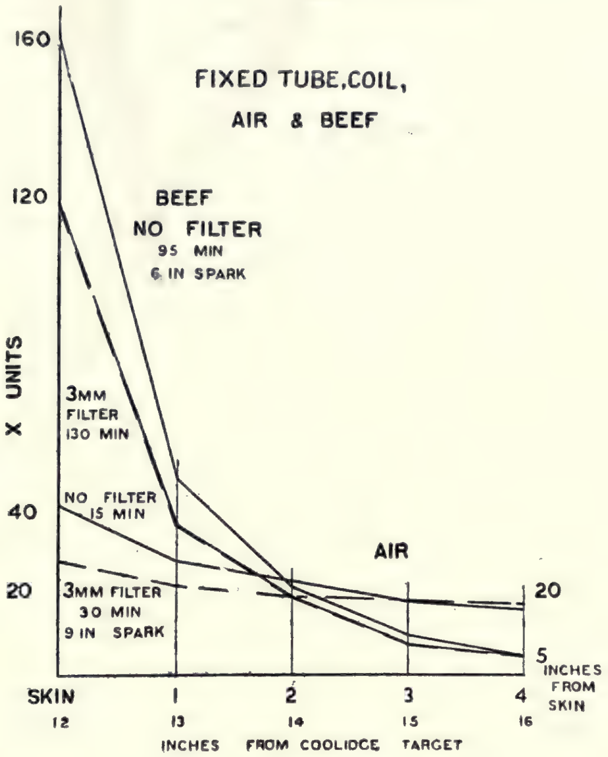


FIG. 32.

EXPERIMENT C.—COMPARISON OF THE EFFECTS OF FILTERED AND UNFILTERED RAYS THROUGH 4 IN. OF BEEF, WITH FIXED AND ROTATING TUBES.

Fixed and rotating tubes through 4 in. of beef. *Filtered and unfiltered, 12 in., 13 in., 14 in., 15 in., 16 in. from target.*

	Fixed		Rotating Tube.	
	No filter	3 mm. filter	No filter	3 mm. filter
Skin	161	118	15	5
1	50	38	7	1
2	22	20	5	0 ?
3	10	8	15	12
Focus	5	5	20	10
	Nineteen runs of 5 min.; 95 min. in all	Thirteen runs of 10 min.; 130 min. in all	Two runs of 1 hour; 120 min. in all	One run of 2 hours; 120 min. in all

Angle, 41°; mean skin circle, 6 in.; 16-in. coil; mercury interrupter. With fixed tube the average readings were: amperes, 4·5; milliamperes, 4; heat, 3·8; spark-gap, 6 in. Rotating tube: amperes, 4·0; milliamperes, 4·5; heat, 3·8; spark-gap, 8 in.

The chief result in this comparison is the diminution of the skin dose when the rotating tube is used; in the unfiltered radiation it is 161 against 15 (10 against 1), in the filtered, 118 against 5 (40 against 1); whilst the focal dose is 1 to 4 in the unfiltered, and 1 to 2 in the filtered

Chart to illustrate Experiment C.

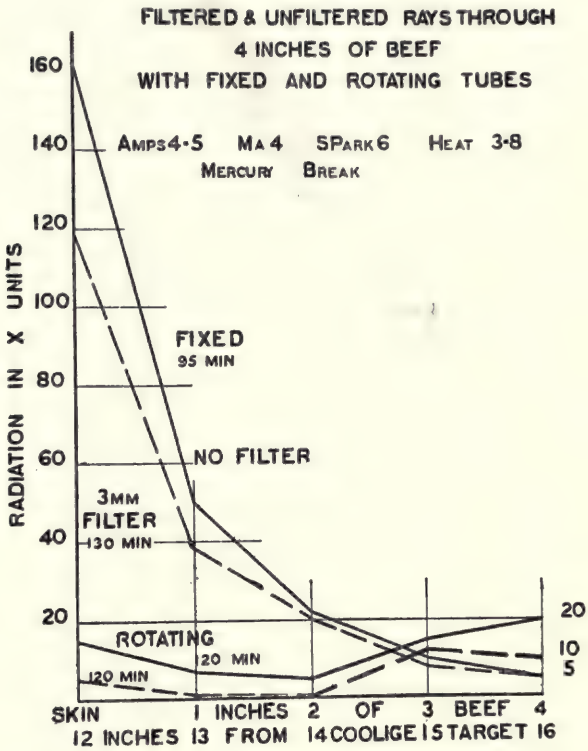


Fig. 33.

The final experiment deals with the comparison of the results obtained with radiations from the rotating tube through beef and air. Rays filtered and unfiltered.

	Coil through Beef		Transformer through Air	
	No filter	Filter 3 mm.	No filter	Filter 3 mm.
Skin	15	5	5	6
1 in.	7	1	7	7
2 in.	5	—	9	14
3 in.	15	10	27	32
4 in. (focus)	20	10	65	73
	120 min.	120 min.	112 min.	240 min.

Angle, 41° ; skin, 6-in. circle ; amperes, 4 ; milliamperes, 4·5 ; heat, 3·8 ; spark, 8.

Angle, 41° ; circle, 6-in. skin ; amperes, 17 ; milliamperes, 6 ; heat, 36 ; spark, 7.

Chart to illustrate Radiations from Rotating Tube through Air and Beef.

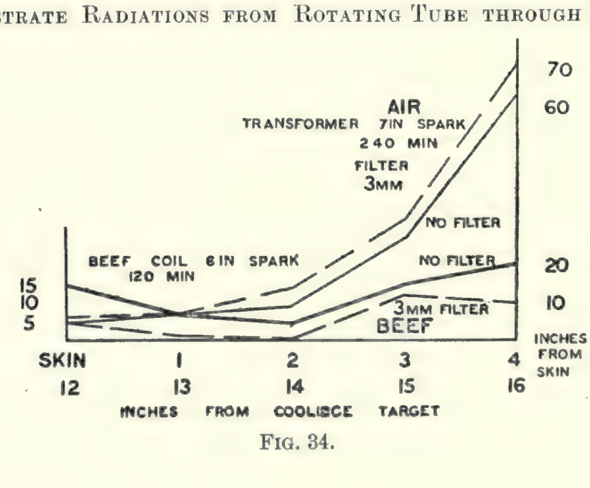


Fig. 34.

Filtered and unfiltered curves nearly the same. Absorption of most of the rays is due to the beef. Curves obtained with rotating tube through beef all drop in the last inch. This is not due to faulty colour estimation as it occurred in three separate experiments, even after adjusting the apparatus.

In conclusion, I wish to express my thanks to Mr. St. George Caulfeild for the valuable help he has given me in constructing the rotating tube-stand, and to both Mr. Caulfeild and Mr. Westlake for the trouble they have taken in conducting these experiments. My thanks are also due to Mr. C. E. Holland, M.A., for the help he has given me in the preparation of the radiographic part of this paper, and especially for the lantern slides of the radiograms which he has made. I trust I have been able to demonstrate the value of the Coolidge tube in radiography and X-ray therapeutics. The experiments dealt with in this paper could have been carried out with no other tube in present use. The advent of the Coolidge tube has opened up many interesting fields of experimental research, and it is my hope that members of this Section will combine in an endeavour to standardize X-ray exposures and therapeutic dosage, possibilities which the new tube seems to justify.

Sir James Mackenzie Davidson.

I do not know that I can contribute much to this discussion, because I had an unfortunate experience with my Coolidge tube. I got one of the early ones, and it punctured almost immediately, and had to be sent back to America, and I only got it back a little time ago. To-night I propose to show you some photographs of the tube which have surprised me, and I thought they might interest the members of this Section.

Fig. 1.

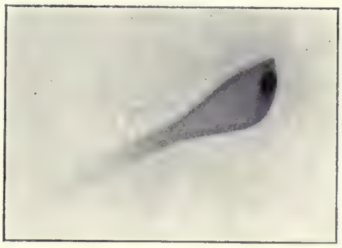


Fig. 2.

Fig. 1.—Pinhole photograph of a Coolidge tube in action. The photographic plate was enclosed in opaque paper envelopes as used in X-ray work. This photograph shows that X rays are given off by the cathode and by the whole surface of the target or anode, extending even along the supporting stem.

Fig. 2.—This photograph was taken in the same way as Fig. 1, only that the tube was placed obliquely—the exposure was less—and so the intense spot indicates the principal focus on the target, but there is the same diffuse production of X rays spread over the surface of the target and along its supporting stem.

The tube was placed on a stand, and the pin-hole was made through a sheet of lead. The diameter was 2 mm., and it was punctured with a needle 2 mm. in diameter, and with a rymer at each side of the plate it was rymed down, so that the pin-hole was at the end of two openings. That could be put into any desired position. The plate was put as a lid on a lead box, so that no scattered rays affected the plate.

Here is a pin-hole photograph, and you will see that a large amount of rays is given off from the whole target. That accounts for the lack of sharpness in some of the photographs which I have taken with this tube: this tube gives off X rays right to the very stem of the target. X rays are given off from the back as well as the front. I cannot explain that, but such is the fact. With a 20-min. exposure you see just an indication of the glass. The glass gives off X rays very feebly. With the ordinary tube the rays do not spread on the target,

but the glass of it gives off a good many more X rays than does the Coolidge tube, as can be seen in a pin-hole photograph.

I wanted to see whether the scattered rays on the target stem were easily stopped, therefore I covered a plate with tin-foil before taking the photograph. The rays were merely a little weakened, otherwise they passed through the pin-hole. I show you a representation of the pin-hole photographs, which you can see stereoscopically.

The use of the Coolidge tube is somewhat dangerous unless the operator protects himself; there is no part of the tube near which you can stand without exposing yourself to the rays—rays more or less powerful.

I believe that some workers have complained of want of definition in X-ray photographs with it, but from Dr. Knox's remarks I gather that he has not experienced this. I do not know what type of tube he uses, but if there is blurring in ordinary photographs with the Coolidge tube, I think it is explained by the fact that many more X rays are diffusely sent off from the whole target; and the fact that the rays come off so richly from the back of the tube makes it unsafe to stand behind the tube, since it does not shield the worker.

Dr. Harrison Orton.

I have made no very special experiments with the Coolidge tube, but I have used it for fourteen months for deep therapy. I feel sure that nobody who has used this tube for deep therapy will return to the ordinary X-ray tube. Firstly, there is an enormous saving of time, for without unduly pressing the tube or overheating it, it is easy to turn a pastille in two minutes. Secondly, there is the possibility of always being able to adjust the tube to give off the same quality of ray as in a previous case, and so you can repeat an exactly similar dose in any given case.

Dr. Knox did not make any special mention of dosage, and it may be interesting to state that for cases of ringworm (using Hampson's scale), if the pastille is turned to tint 14, it is ample, with the Coolidge tube, to produce epilation without redness. Working with a 3 mm. aluminium filter, I have been accustomed, when using an ordinary X-ray tube, to give a dose at one sitting of 20 X in uterine conditions and when treating tumours through the skin, but I find you cannot do this with safety when using a Coolidge tube: you should go a point or two below this in order to avoid dermatitis. But by giving 10 X in one dose, and after an interval another 10 X, the 20 X dose is given without causing dermatitis.

In starting a Coolidge tube it sometimes behaves rather peculiarly until the anticathode has become hot. It is advisable therefore to start with a current of about 4·4 amp. through the filament, and continue that until the anticathode is hot, before passing a heavy current through the tube. I think that a failure to do this is responsible for some of the punctures which have occurred. Another point is, that before the anticathode becomes thoroughly heated, the tube is not absolutely constant, and if you adjust the tube for a certain penetration, then when the anticathode becomes very hot the penetration will fall somewhat, and it should be readjusted. But if when the anticathode is thoroughly heated you adjust it, it will then run for hours on end with a current of 4 ma. or 5 ma. running through it, without any change in penetration of the rays. It is said by the makers, and probably it is true, that when the anticathode is cold the tube suppresses inverse current; but this is not true when it is heated. When this is the case the tube will behave as badly as any ordinary one if the inverse current is not thoroughly cut out. Since all valve tubes cut off some current in the right direction, I think that the new instrument which Sir James Mackenzie Davidson has described will be very useful in enabling us to get more power.

I have not done therapy with the electrolytic break, but with a large mercury break, 20-in. coil, and penetration of 8 to 9 Benoist, I cannot get more than 4 ma. or 5 ma. through the tube.

With regard to the cost, the original tube I got fourteen months ago I still have in nse. About six months ago it began to behave peculiarly, and that is what first drew my attention to

the valves being defective and some inverse current getting through. As I thought it would break, owing to its irregular behaviour, I ordered another. However, on putting in new valves the old tube has run quite steadily, and I have not yet had to use the new one.

With the Coolidge tube one requires no apparatus for running water to cool the tube, neither does one need a rhythmic interrupter, and I think the cost will not be found to be excessive. With care, the life of this tube seems to be a very long one. I have never forced mine. I know some pass as much as 10 ma. to 20 ma., but for therapy I do not pass more than 5 ma. or 6 ma., and with that current the tube has been in almost daily use, and has run steadily for over a year.

Dr. N. S. Finzi.

I am afraid I have no figures nor experiments to bring before you on this subject: my observations on it will be purely clinical. With regard to radioscopy, I find one can get fairly good results with the Coolidge tube, but I am not satisfied that one can obtain the very best detailed work with it compared with the ordinary tube with a tungsten target. I do not think one gets the same fine detail in the case of the lungs, for instance. For bismuth meal work, of course, the Coolidge tube is ideal. Whether it is the bluntness of the focus, even in the fine focus Coolidge tube, or the secondary rays given off from the tube, or the fact that one does not get the same spectrum of rays, I cannot say. I am inclined to suspect that some of the medium soft rays which one gets from the ordinary X-ray tube are not so numerous, that is to say, the rays which are most useful for taking delicate negatives. One can get exceedingly soft rays and exceedingly hard ones, but whether with this tube we get so much of the middle ratios I am inclined to doubt. I have no figures upon which to base this statement: it is an impression, and I hope physicists will be able later on to enlighten us upon the point. If one has a feeble apparatus, no doubt it is better to use a Coolidge tube, because it has nearly double the efficiency for the same current through the coil as compared with the ordinary X-ray tube; at any rate it is considerably more efficient.

With regard to radio-therapy, I am afraid I have been working on rather heroic lines—that is, I have been getting the dosage down to as short a time as I could conveniently manage. My ordinary time now for a pastille dose (5 H.), measured through $3\frac{1}{2}$ mm. of aluminium, is $2\frac{1}{2}$ min.; for 7 H. it is $3\frac{1}{2}$ min.; for 8 H. 4 min. The same amount of rays used without a filter give a pastille dose in 50 sec. I have successfully used this for epilation: the whole five areas of exposure, with the use of the Kienböck method, were done in well under half an hour. The exposure times varied from 48 sec. to 54 sec. each, the variation being due to the fact that the tube was hotter for some exposures than for others. As the target gets hotter the tube gets softer, unless one alters the heating current. The current I passed through for these exposures was 10 ma. to 15 ma. Of course, the anode gets absolutely white-hot, and glows like a tungsten lamp, and in order to keep the glass of the tube cool, I have got an air-blower. If I were setting up a new one, I should have an air-sucker, on the principle of the vacuum cleaners; this would have the additional advantage of sucking away the ozone and the nitrous fumes which attend this work.

As to the dosage, I agree with Dr. Harrison Orton that one cannot give quite such a big dose of filtered rays with the Coolidge tube as with the ordinary tube. I used to find that I could give about $7\frac{1}{2}$ H. to 8 H. to most patients with the ordinary tube, but with the Coolidge tube this goes down to about 7 H.

I am convinced that no one who has used the Coolidge tube for treatment will care to go back to ordinary tubes, unless it can be proved to them that the Coolidge will not give as good results. I think the results are neither better nor worse than those we used to obtain with the use of the older tubes, but the conveniences of working with the Coolidge tube are enormous: you can set your tube to do a certain thing in a certain time, and you can rely on it doing the same thing each time.

With regard to the break to be used for a Coolidge tube, I have used the mercury break

and I have used the Wehnelt break, and I infinitely prefer the last-named: the steadier voltage which one gets with it seems to suit the Coolidge tube better, and one can work it harder without sparking round the tube. With the mercury break I find a great tendency towards sparking round the tube, or across the alternate gap, if the tube is worked hard. I find that if a mercury break is used the best method of working is to use very rapid interruptions and a low induction in the primary of the coil. For therapy with the ordinary tube I prefer the highest induction and the slowest break, but with the Coolidge tube the conditions seem to be reversed. Another observation is, that if you are using a mercury break, and keeping the heating current through the spiral constant, you increase the current through the primary of the coil, the milliamperes in the tube decrease, because the secondary voltage is increased and the tube gets harder. If you are using a Wehnelt break, this does not occur to the same extent—*i.e.*, the secondary voltage is not increased to the same extent by increasing the current in the primary.

As to cost, my first tube lasted me four and a half months, and then the filament broke: I think it was broken when I received it, but not badly enough to prevent working. My second tube failed two days ago, having lasted me thirteen months, and then it went wrong by accident: I was doing some experiments with it and sparked it. I think the Coolidge tube will not be found to be more expensive than the ordinary tube.

Dr. Saberton (Harrogate).

I have not made any experiments with the Coolidge tube, so my remarks will be purely clinical and confined to a narration of my experiences with this tube. Speaking from the radiographic point of view, I have not succeeded in obtaining so good a negative with the Coolidge as with an ordinary tube; there appears to be a lack of definition or sharpness and a want of fine detail. This may be due to the fact that the tube used was one of the first to come over to this country, and had a very diffuse focus; perhaps later models have a sharper focus. Another explanation may lie in the fact that the rays emitted by the Coolidge tube are of a uniform type or vibration, whereas the vacuum of an ordinary X-ray tube will vary during an exposure and emit rays of varying rates of vibration; this latter characteristic appears to me to be a valuable factor in the production of a good negative. I have had considerable experience in the therapeutic use of the Coolidge tube. In cases of tinea I have found it necessary to push the dose beyond the Sabouraud B tint in order to produce epilation, my experience in this respect being exactly the converse of that of Dr. Orton and Dr. Finzi. The cases of tinea have been treated with fairly soft rays corresponding to a reading of 6 on the Bauer qualimeter. I gave the usual Sabouraud dose to the first three or four patients and failed to produce epilation. In the next two cases the Sabouraud B tint was exceeded; this dose produced a partial epilation. To the next patient I gave about 1¼ Sabouraud, and this produced complete epilation without any erythema. I fail to understand why one worker finds it necessary to give less than the usual epilation dose and another has to augment the dose beyond the normal to obtain the same result.

In cases of pruritus I find unfiltered rays between 6 to 7 Bauer most successful. For purposes of deep therapy the Coolidge tube appears to me to be ideal to work with, and one obtains most gratifying results. I am accustomed to run the tube with an alternative spark-gap on my apparatus of 27 cm. to 30 cm., corresponding on the Bauer scale to a reading between nine and ten units, this being the maximum output of the apparatus. With 3 ma. passing through the tube and measuring the dose after filtration through 3 mm. of aluminium, it takes me 10 minutes to obtain a full Sabouraud dose. I have repeated this dose once a fortnight on the same area of skin and it produces excellent pigmentation.

I was very pleased to hear Dr. Knox remark on the desirability of standardization of dose in X-ray therapy. I regret that so many of our members still appear to measure their dose on the tube side of the filter, and cannot understand why this practice is persisted in, especially as it is easier, and, in my opinion, more scientific to measure one's dose after filtration.

With regard to the terms "penetration" or "penetrating rays," these have always appeared to me unfortunate expressions. I may be dull, but I fail quite to understand it. One can appreciate the fact that a certain proportion of the rays, whether soft or hard, are absorbed in passing through the tissues, but I do not understand the statement that soft rays are absorbed by a few centimetres of tissue. One is accustomed to take radiograms of the thickest part of the body with a soft tube; there is no question of penetration—we get our radiogram.

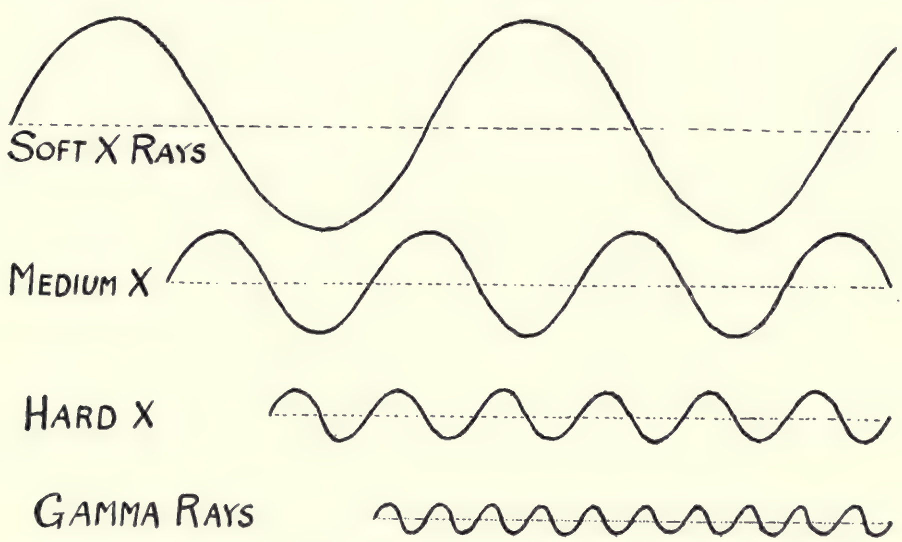
Dr. Knox ruled out the high-tension transformer with the Coolidge tube for therapeutic work, though we are told it is excellent for radiographic work. I presume this is due to the high-tension transformer having insufficient voltage to back up a 10-in. or 12-in. alternative spark-gap on a Coolidge tube, and shortening between the high-tension collectors. Provided a high-tension transformer will back up a 10-in. alternative spark-gap, I do not see why it should be ruled out for work with the Coolidge tube. My work with the Coolidge tube has, so far, been done with a specially wound 16-in. coil and large Dreadnought interrupter.

Dr. Finzi appears to be going in for speed work in therapy, but I am not sure that in this the time factor is not an important one. Assuming that one gave a "flash" treatment, would it have the same effect as an exposure of 8 min. or 10 min., although the amount of rays in both cases received by the tissues is the same? Personally, I should not expect the effect on the cells to be the same as with a time exposure.

As regards cost, the Coolidge tube well repays its expense. I have used one daily for seven or eight months, but unfortunately a few days ago it was accidentally broken. Apart from an accident, I see no reason why it should not have run on indefinitely.

Dr. S. Russ.

I am very much interested in the discussion on the Coolidge radiation, and I should like to show you a slide which deals with an aspect rather different from those which have been touched



Scale of wave-lengths; 1 cm. represents 0·71 Angström unit.

upon in the discussion. To some of us, the great interest in the advent of the Coolidge tube is the possibility it has opened up of producing X rays of the same penetrative power as the gamma rays of radium.

The possibility of producing X rays of the same wave-length as the gamma rays was put to a very stringent test by Professor Rutherford and his colleagues in Manchester, and they published their results in the *Philosophical Magazine* of last September. They found that whereas they could produce X rays of as short wave-lengths as the gamma rays of radium B, the minimum wave-

length they obtained was rather more than twice that of the hardest gamma rays from radium C. The diagram shows the difference in the wave-lengths of soft, medium, and hard X rays. The ratio of wave-lengths for the hardest gamma rays from radium C and the hardest X rays which have so far been produced is as 0·71 is to 1·72. The authors give good reasons, in their paper, for believing that there is very little possibility, under ordinary experimental conditions, of producing X rays of shorter wave-length than 1·7 by 10^{-10} metres.

With regard to one or two questions which have been raised in the discussion, I have been interested to find that several observations I made myself, purely from the experimental side, have been noticed by other people. Two were especially noted by Dr. Orton: firstly, that as the tube runs, there is a slight drop in its working potential difference. It does drop in voltage, and you have to readjust your current in order to maintain the character of the radiation. There is also the question of it carrying the inverse current. I remember that when I got my tube, which I have had for eighteen months, the manufacturer told me that one feature of the tube was that it would not carry an inverse current. So when it had been running a few minutes, I suggested that we should try it in that particular; the result was that the milliamperes registered a slight increase on reversing the direction of the current.

With regard to the point Dr. Finzi raises, as to the difference in the composition of the beam in the two kinds of tube, personally, I think that if there are differences, with the same strength of current, they are very small, not sufficient to account for the differences he noticed radiographically. I should be much more inclined to attribute those differences to the fact which Sir James Mackenzie Davidson brings out in his pin-hole photographs—namely, that there is radiation from the whole stem of the anticathode. This very point which Sir James brought forward was noticed by Mr. Coolidge himself, because in a recent paper in the *American Journal of Roentgenology* he suggests, as an explanation, that the electrons, as they come from the heated spiral, are repelled from the negatively electrified glass surface, and so find their way to the anticathode and there produce X rays.

I should like to add that my personal feeling is that we owe a great debt of gratitude to Mr. Coolidge for his invention. I think it is the most wonderful X-ray tube that has ever been constructed, and I feel sure that this is only a beginning of what we are going to hear of the Coolidge tube in the future.

REVIEW.

Treatise on Fractures. By J. B. Roberts and James A. Kelly, pp. 661, 909 illustrations. Published by J. B. Lippincott Co.

This book weighs 3 lbs., consists of 661 pages, possesses 909 illustrations, and in regard to paper, print and printing, leaves nothing to be desired.

But fractures have been so well and so copiously treated that more than this is needed to justify another three pounds on the subject. This book follows traditional lines—a concise table of contents, a detailed list of the 909 illustrations, and a first chapter of general considerations dealing with the varieties, symptoms, and causes of fracture, in which nothing new will be found beyond a useful table showing the percentage frequency of particular types of fracture in different cliniques.

The first chapter is followed by a description of the operative treatment of closed fractures. Most stress is laid upon Lane's technique, but Albee's method of bone grafting is also referred to. However, no attempt is made to leave the student any wiser as to which method is the better or the more applicable to particular cases.

Chapters three to twenty-six are devoted to regional fractures. There are reproductions of very numerous skiagrams, many quite good,

the majority qnite moderate, and some very poor indeed. In Chapter twenty-seven is an interesting and well-illustrated account of fractures of the small sesamoids, a subject which has not as yet received very much attention.

On the whole it is a disappointing book in regard to matter, and the disappointment is not alleviated by the loose and slipshod manner in which the subject is presented. Literary gaucheries abound, commas are under no sort of control, and any attempt at continuous reading is a tiring exercise.

With particular reference to skiagraphy, it is surprising to find no reference to the value of stereoscopic radiography, which, in the hands of English radiologists, has given such brilliant results in the elucidation of complicated fractures.

The difficult and puzzling subject of absorption of lime salts in damaged bone is not referred to. Nor is any mention made of that important complication of trauma, myositis ossificans. The vagaries of callus formation, the method of production and the life history of sequestra, the influence of septic infection upon compound fracture, are all subjects concerning which information must be sought elsewhere.

NOTES AND ABSTRACTS.

RADIUM-THERAPY.

Four Cases of Actinomycosis treated by Radium.—S. A. Heyerdahl (*Norsk Magazin for Laegevidenskaben*, September, 1916).

Case 1.—A warehouse employé, 44 years of age, who was removed to the radium ward from Surgical Ward A on the 4th of May. The patient's disease had first shown itself four months before his admission to the ward, by a slight swelling, under the skin, above the right lower jaw; by degrees this increased and gradually a densely hard infiltration developed in the soft part of the neck, which reached on the right side as far as the mastoid process, down to a few inches above the sterno-clavicular articulation and extended beyond the middle line of the throat in the direction of the left armpit. The tumour was tender to the touch; the skin was red; deep down, fluctuation was perceptible, and in the pus from the abscess the bacillus of actinomycosis was observed. On the 4th of May the radium treatment was applied, 20 centigrams of radium in tubes, in twenty-four hours, through a lead filter 1 millimetre in thickness. On the 9th of June was repeated, with, approximately, a half dose; on the 30th of July the patient had his final radium treatment (4 centigrams in twenty-four hours). He was discharged cured and has been well since.

Case 2.—A lad of 17 was admitted to the radium ward from the out-patients' surgical department on the 25th of February, 1914. In the beginning of December, 1913, he had felt pain in the throat when swallowing; simultaneously the left cheek and the left side of the throat, under the ear, began to swell up. The swelling gradually increased an abscess formed, from which thin pus was discharged, with small granulations in it; later on, more abscesses formed. At the time of his admission to the radium ward there was a diffuse, but well established infiltration of the left cheek, extending to the arcus zygomaticus and the ear; the infiltration extended some distance down the neck, the surface skin was markedly affected, and on the infiltrated portion several fistulæ were visible. Inside the mouth, on the mucous membrane, above the anterior molars, there could be seen a prominent swelling, as large as a bean, with a pus focus in the centre. Here also several glands were noticeable upon the neck, along the further edge of the sterno-cleido-mastoid muscle, and in the hollow above the collar-

bone; they were the size of beans, hard, and showing no tenderness to the touch. The radium treatment was begun on the 25th of February, 1914. In all, 21 centigrams in tube preparation were applied outwardly for twenty-four hours, through a lead filter 1 millimetre in thickness; and a superficial preparation 2 centimetres square was applied to the inside surface of the mouth for five hours (lead filter ½ a millimetre thick). The radium treatment was repeated, in a half dose, on April 19th, to prevent a return of the disease. The patient was then well, and has since had no return of the disease. The last time I saw him was one year after the radium treatment (13th February, 1915).

Case 3.—A mason by profession, 79 years of age, who was removed from R.H.'s Surgical Ward A to the radium ward on the 15th of January, 1915. He had been in the surgical ward since the 19th December, 1914, with actinomycosis of the neck; the disease developed during the course of five weeks; while he was in the ward an incision was made on the outside of the neck, from which a quantity of pus was discharged; granulations of actinomycosis were found in the pus. The patient was removed to the radium ward for radium treatment. On his admission to the radium ward the soft part of the left side of the neck was infiltrated by a large, flat, densely hard tumour about 10 centimetres square, which extended a few centimetres beyond the middle line of the neck and back to the anterior edge of the sterno-cleido-mastoid muscle, and from the collar-bone to the lower jaw. The tumour was immovably fixed upon the substructures, the skin was corrugated, infiltrated, bluish-red; from the incision pus flowed.

This was a distinctly severe case of actinomycosis of the neck, and one which was growing worse. The patient had his first radium treatment on the 15th of January, 1915; 10 centigrams in tube form were applied in twenty-four hours through a lead filter 1 millimetre in thickness; in addition, a superficial preparation was applied through the same thickness of filter. A few days after the beginning of the application of radium, a distinct diminution of the disease could already be observed (which is recorded in the journal).

On March 2nd the radium treatment was repeated, with approximately the same dose. The actinomycosis swelling was now much reduced; it now extended to the middle line of the neck, upwards to a distance of two fingers' breadth below the lower jaw, downwards to a distance of two fingers' breadth above the collar-bone, and backwards as far as the external edge of the sterno-cleido-mastoid muscle. The infiltration was now much flatter. On the 19th of April the patient again had radium treatment, with the superficial preparation as after treatment. He was then cured and has since been well (last time was 20th August, 1915).

This is the first case of actinomycosis cured by radium treatment which has been described at all exactly. This patient is alive and well. In order that the effects of the treatment might be observed as well as possible, none of these patients whose cases I have described have been given iodide of potassium or any other internal treatment after the radium treatment was begun.*

RADIOLOGY.

Experimental Researches on Utero-ovarian Radiology.—G. Serafini (*La Radiologia Medica*, July-August, 1916).

The author describes experiments designed to investigate the direct action of Roentgen rays on the ovary and uterus, and the indirect effect on the uterus and other organs of the action of the rays on the ovary. For the purpose of these experiments he used rabbits, preferably from the same litter and with as much similarity as possible in weight, feeding, and other conditions.

In the first experiment four similar animals were taken; one was exposed to the action of X rays alone, another to X rays after destruction of the ovaries; the third was deprived of ovaries but not treated by rays, while the fourth was untouched and served as a control.

Irradiation was performed at four sittings,

* A fourth case of pronounced actinomycosis of the neck, chest, and both armpits, which was also treated by radium, died after the lapse of four months, from increasing anæmia and marasmus.

the animal being fixed in position, the anticathode 16 cm. from the skin of the supra pubic region. Rays of the quality of 8 to 9 Bauer were applied through a filter of 2 mm. of aluminium.

The experiment began on January 5th, the animals were all killed on March 18th, and the uterus and ovaries of each subjected to examination both by dissection and by microscopic section, every precaution being taken to avoid errors due to varying conditions.

It was found that after the simple ovariotomy the uterus was very much atrophied; it was less affected where treatment had been given as well, while the largest development was in the rabbit which had been treated by X rays alone.

Many more experiments were then designed to test and control every point in the problem, and these are described in full detail.

The author sums up his results as follows:—

1. Irradiation of the ovary produces a period of inhibition of its function. This is especially characterised by a constant absence of the formation of the corpus luteum, while the interstitial portion is well developed, functions well, and may even be comparatively hypertrophic.

2. The absence of the corpus luteum is the cause of the atrophy of the uterus when the ovary has been destroyed.

3. The X rays act indirectly on the uterus, through the ovary, possibly by an exciting action on the interstitial glands. They also act directly on the uterus itself. Under the exact conditions of technique and dosage that were used in these experiments the result was hypertrophy of both muscular and mucous elements of the uterus.

4. Treatment of the ovaries—both by X rays and by removal—causes signs of increased activity of the pituitary gland.

5. Removal of ovaries causes increased activity of the pyneal gland, while their treatment by X rays seems to cause a decrease of function.

6. The basis of the experiment is the "distant" action of X rays on the glands of internal secretion. N. B.

A Plea for Conservatism in the Treatment of Closed Fractures from a Roentgenological Standpoint.—S. B. Childs *(American Journal of Roentgenology,* August, 1916, p. 390).—The writer, after years of experience in the examination of recent fractures, and in the demonstration of end results in cases where there has not been complete apposition of the fragments, is against the wholesale and indiscriminate operations upon closed fractures that are being done daily and has formed the following conclusions:—

Perfect apposition or alignment of a fracture is not necessary to obtain a good anatomical or functional result, or both.

With fair alignment in a fracture, although some antero-posterior or lateral displacement exists, preferably not to exceed one-half the diameter of the shaft of a weight-bearing long bone, a good functional result can be expected, but a longer time for union must be anticipated.

In Pott's and Colles' fractures, a proper alignment of the axis of the shaft of the tibia to the astragalus, and the axis of the shaft of the radius to the space between the second and third metacarpals, although the ends of the fragments of the fracture are not in close apposition, will probably give a good anatomical and functional result. It must not be forgotten, however, in these fractures as well as in a fracture in any part of the body, especially in the neighbourhood of a joint, that the damage done to the soft parts at the time of the injury is often an important factor in the failure to obtain a good functional result.

In cases where doubt exists as to the probability of obtaining a good functional result in a fracture, provided the displacement of the axis of the shaft of the bone or the fragments is not too great, the patient or the family should be acquainted with the facts, and told that the chances of success in obtaining a good result in a series of similar cases without an operation will be about ninety per cent., but if failure results the subsequent operation can often be performed with equally good prospects of success, as if done in the recent fracture. Their wishes or decision in the matter should be given due consideration.

Care should be exercised to inform the

patients that occasionally non-union results from some constitutional condition, or unknown cause, although the ends of the fracture are in good position. This is particularly true in fractures of the neck of the femur, in elderly people.

A certain small proportion of closed fractures, probably less than ten per cent., require an open operation for proper fixation of the fragments. These cases should be carefully selected, and an operation decided upon only after the attending physician or surgeon has satisfied himself that a sufficiently good alignment of the shaft or fragments cannot be maintained by external fixation, to warrant the assumption that a good result can be expected.

Ununited fractures, after six to eight weeks, in which deficient callus formation is apparent, should be treated constitutionally if indication therefore exists, and the patients should be encouraged to use the limb, with adequate ambulatory splint, or other local treatment instituted, before an immediate operation is advised. In many of these cases following these procedures solid bony union will result in a comparatively short time.

R. W. A. S.

RADIOGRAPHY.

Some Observations upon the Respiratory Movements of the Heart and Diaphragm.—G. W. Holmes (*American Journal of Roentgenology*, May, 1916, p. 243).—The writer's technique is described in detail. The following are some of the findings in this preliminary report, though it is stated that the material in hand at present is not sufficiently large to form a basis for definite conclusions.

Normally, there is a fairly definite relation between the excursion of the left border of the heart and that of the diaphragm with forced respiration. The relations vary somewhat in different types of chests, and may be influenced by disease other than pericarditis.

With the heart adherent to the pericardium, there is a decrease in the excursion of the left border of the heart as compared with that of the diaphragm.

In the so-called ptotic type, there is a marked limitation in the downward excursion of the diaphragm when the patient is standing, but this limitation disappears in the prone position.

The paper is illustrated with tracings in normal and diseased conditions.

R. W. A. S.

"X-ray Efficiency in Bladder Diagnosis."—(*Interstate Medical Journal*, August, 1916).

Dr. G. S. Peterkin strongly urges the routine radiographic examination of the bladder in all disordered conditions of that viscus, and not merely when calculus is suspected. He claims the following advantages for such a course of procedure:—

1. Evidence may be obtained of lesions often unsuspected, and not otherwise demonstrable.

2. If the bladder be distended with material of low specific gravity, such as air or oxygen, a picture can be obtained of small foreign bodies and sometimes of tumours within the bladder.

3. If the bladder be filled with a solution of high specific gravity a radiograph will give evidence of its form and capacity, and also of the presence of such abnormalities as sacculations. It will also show the presence and approximate size of large tumours, and, when the bladder has been emptied again, will frequently show ulcerations and small irregular growths such as papillomata, by reason of the opaque medium adhering to the rough surface. In females it will also demonstrate adhesions of the bladder, or pressure on it by neighbouring organs.

4. It gives information as to size and number of calculi, and especially as to their presence behind the prostate, in sacculations, or in the intramural portion of the ureter, in all of which positions they might be missed on cystoscopic examination. It will disclose if a foreign body be the nucleus of a calculus—a factor which, if not known, might complicate removal.

5. In conditions which obscure the cystoscopic view, such as hæmorrhage, pronounced inflammation, diminished capacity, etc., radiography is very useful. In his own practice Peterkin uses X rays as a routine measure after, as well as before, operations for prostatic

hypertrophy to ascertain the result of the treatment.

6. Serial radiographs demonstrate the progress of disease or the effects of treatment.

The position he adopts for vesical radiography differs from that usually advocated. The patient lies prone in what is practically a reversed Trendelenberg position, the buttocks being the highest point at the apex where the two slopes meet, and the trunk sloping down one way, whilst the legs lie on the opposite slope. The plate is placed beneath the patient, and the tube above, with its cylinder diaphragm pressed against the buttocks and inclined towards the head at an angle of 65 degrees.

He contends that in this position calculi and foreign bodies will gravitate towards the anterior wall of the bladder, and thus come nearer to the plate, and that the pressure of the abdominal organs on the bladder is relieved, and thus allows it to rise well above the pelvic brim.

The opaque solution used to distend the bladder is normally a 5 per cent. solution of silver iodide, but this can be reduced to 2 per cent. in the case of thin patients.

The following are amongst the cases with which the paper is illustrated:—

1. Symptoms of prostatic enlargement. Urinary examination negative. Clinical and instrumental examination of prostate showed no abnormality. Repeated cystoscopic examination by several operators, including Peterkin himself, furnished no diagnosis. A radiograph, taken after the bladder had been filled with the silver iodide solution, shows a sacculation connected by a neck with the bladder. As soon as the sacculation became filled the neck elongated and contracted, thus closing the opening into the bladder, and then cystoscopic examination merely gave a picture of uniform trabeculation.

2. Urine examination disclosed a large amount of pus, blood, and various micro-organisms. Cystoscopy was practically negative. Radiography showed sacculation of the bladder, calcareous prostate, complete destruction of the internal sphincter, and assumption of urinary control by the external one. In this and another case X rays were used to demonstrate the condition of the sphincters by the presence or absence of distinct lines of demarcation in the shadow of the opaque fluid at the positions of the sphincters. A normal case is included for comparison.

3. Urinary examination showed a mixed microbial infection. The leading symptom was frequency of micturition (every half to one hour day and night for two years). Cystoscopic examination negative. Bladder contracted to 2½ ozs. capacity. The radiograph showed multiple sacculations.

Several other cases are noted in which radiography corroborated and enlarged information obtained by cystoscopic examination.

H. M. B.

Failure of Radiography to Disclose Calculi in the Urinary Bladder.—Hyman (*Interstate Medical Journal*, Aug., 1916) discusses the failure of radiography to disclose calculi in the urinary bladder. He quotes Beer's paper (*Journal of the American Medical Association*, October, 1913), on a series of 22 cases of vesical calculi which were radiographed. In this series only six cases showed any evidence of calculus on the plate. In the 16 cases where X rays failed to demonstrate the condition cystoscopy was successful every time. Chemical examination of the calculi showed that they were all composed of uric acid or of urates.

Hyman has collected an additional series of 35 cases in which radiography was successful 16 times, and failed in 19 to show the calculus. All of the cases except two were demonstrable by the cystoscope, but in the two cases the cystoscope could not be introduced owing to prostatic enlargement, and the diagnoses were made with a stone searcher. In a few of the cases the stone could be palpated bi-manually.

The calculi which failed to show varied in size from that of a marble to a hen's egg. Ten of them were analysed with the following results:—Three were uric acid, two were uric acid and urates mixed, three were urates only, one was ammonium urate and calcium sulphate, and the remaining one was composed of phosphates with a trace of uric acid. Those calculi which cast a distinct shadow were mainly composed of carbonates, phosphates, and oxalates.

Hyman has tried a few times to obtain a radiograph of a calculus which was otherwise

invisible by coating it with an opaque silver salt, but has not been successful. He also tried air inflation of the bladder in a few cases, and in one of them obtained a suggestion of a shadow where a stone had previously been present. He considers the cystoscope the best method of diagnosis, but that where calculus is suspected, and the cystoscope cannot be introduced, these methods are worth a trial. H. M. B.

The Radiographic Efficiency of the Coolidge X-ray Tube.—W. S. Gorton and J. A. C Colston (*American Journal of Roentgenology*, August, 1916, p. 388).—These investigators have made a series of observations on the comparative efficiency for radiographic work of the Coolidge tube and of the ordinary form of X-ray tube.

The apparatus was a 10 K.W. transformer a Coolidge tube of the medium focus type, and a 7-inch tube of the ordinary type with a tungsten target, and a 4-inch spark gap was used during most of the work, this length of spark-gap being the actual value throughout the exposure.

Their observations were limited to the examination of the urinary tract.

The results of experiments on the absorption of X rays formed a basis for a table used by them giving the relation (for any one value of spark-gap) between the thickness of the patient in inches and the length of exposure in milliampere-seconds.

The outstanding result of their work is that on the average the Coolidge tube gives as good pictures as does the ordinary type of tube. The best pictures obtained from the Coolidge tube are not quite as good as the best obtained from the ordinary tube, but the difference is very small.

The pictures obtained by the medium focus Coolidge tube were not inferior in sharpness to those obtained with the ordinary tube.

Better pictures were obtained with the use of a compression diaphragm than without one, and better results without an intensifying screen than with one. A surprising feature was the amount of time required for the exposures. For the same value of spark-gap and current through the tube, the Coolidge tube was found to require an exposure from two to three times as long as that required by the ordinary type of tube. This means that the ordinary tube under the conditions specified gives out a far larger quantity of X rays than does the Coolidge tube. This does not mean that the Coolidge tube is less efficient as a producer of X rays; the condition is almost certainly due to the characteristics of the milliammeter. This instrument indicates an average value of all the instantaneous values assumed by the current. In the Coolidge tube the current cannot increase more than a certain amount, whereas in the ordinary tube there is a rough proportion between the current and the voltage. The result is that in the ordinary tube a larger proportion of the current passes when the voltage on the tube is high, thus producing a greater quantity of X rays than is the case when the current has a limiting value.

The results of the work may be summarised by saying that the Coolidge tube gives as good results as does the ordinary type of tube with much simpler manipulation, but at the cost of an increased exposure. R. W. A. S.

The Use of Oxygen in Cystography, with a Preliminary Report on the Use of Oxygen in Pyelography.—A. Granger (*American Journal of Roentgenology*, July, 1916, p. 351.—The writer states he has used washed and filtered air to distend the urinary bladder, and though the results were very satisfactory, from the radiographic point of view, the air was not well borne by the patient. He next used oxygen because it is easily obtainable, does not harm the tissues, and has mild antiseptic and analgesic properties. It is therefore well borne by the bladder, permits of much greater distension in painful and irritable bladders than is possible with either air or boracic solution, and is easily retained and as easily expelled.

He quotes the case of an irritable and painful malignant bladder, which was distended with oxygen for several minutes with no pain.

Granger finds that under these conditions calculi show up with remarkable clearness, and he doubts whether a very small calculus in one case, and one in a patient of over 20 st.

weight in another case, could have been demonstrated by any other means.

In addition to this, the whole outline of the bladder is distinctly seen, and if unyielding from infiltrations or adhesions, this is shown up. Growths, diverticula, and other deformities of the bladder are easily diagnosed, while the shadow of an enlarged prostate is also made out.

The technique he employs for cystographs is as follows:—

The urine having been withdrawn through a catheter, the tube coming from the oxygen apparatus is then connected to the catheter. The bladder is distended slowly with a pressure of about one pound. When the patient notes that his bladder is full, the flow of oxygen is interrupted for a few seconds. The flow is resumed at intervals until the intravesical pressure registers about two pounds. Most patients will stand that much without pain and little or no discomfort. When the intravesicular pressure is about two pounds the catheter is removed. The patient is made to lie in a prone position, his thighs elevated, and the tube-holder tilted at an angle which will cause the normal ray to pass from behind forward through the middle of the lower half of the sacrum. This throws the entire outline of the bladder above the symphysis, where it can best be examined, and the shadows of small calculi, not intercepted by those of the bony pelvis, can be made out clearly.

He next used oxygen in pyelography, and among his difficulties were the differentiation of the injected gas from gas in bowel, the absorption of some of the oxygen if the bladder was distended with fluid at the same time, and the pressure of the cystoscope and solution made the operation uncomfortable and tedious for the patient.

As to the differentiation from gas in bowel, Granger believes that after a hollow organ becomes normally distended with gas, a slight increase in the pressure within limits yet to be determined accurately, and a slight continuance of this normal pressure does not noticeably increase distension of the organ, but increases its contained gas, with resulting increase in contrast, and he hopes that this may serve to distinguish between the two conditions. He also says it is not impossible to obtain, after thorough preparation, a practically gas-free bowel.

Granger has adopted the following technique for pyelography:—

1. The patient is cystoscoped and the ureteral catheters inserted.

2. The solution is withdrawn and then the cystoscope removed without disturbing the ureteral catheters. The patient is then moved slowly in position over the plate-changing device.

3. A very small urethral catheter is introduced into the bladder, connected to the oxygen equipment, and the bladder filled with oxygen as for the cystogram.

4. The urethral catheter is removed without disturbing the ureteral catheters.

5. Everything being in readiness to make the pyelogram the ureteral catheters are connected to the oxygen equipment, the gas allowed to flow, and the exposure made while the gas is flowing in.

The all important point is to distend the bladder at a slightly higher pressure than the pelvis and ureters, as this will effectively prevent leakage into the bladder.

The paper is illustrated with radiograms illustrating the oxygen distension of bladder, renal pelvis, and ureter. R. W. A. S.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

SIMPLE METHODS OF JAW RADIOGRAPHY.

By H. Annesley Eccles, M.D. (Lond.)

Radiographer to the Croydon War Hospital (Jaw Section), and to the Croydon General Hospital.

The subject of Jaw Radiography has hitherto received only scant attention. This has been due, no doubt, partly to the fact that this portion of the body has been so seldom injured, and also to the difficulty encountered in making skiagrams of this region sufficiently clear and precise. The present war has removed the first cause, since injuries to the jaws are by no means uncommon in modern warfare, and better technique is rapidly removing the second.

Major Hall-Edwards, in his paper in the Archives of the Roentgen Ray of March, 1915, says that on looking through the reports of the Proceedings of the Odontological Section of the Royal Society of Medicine, he has been struck with the paucity of the articles in which there are to be found mention of dental radiography, and that the only articles worth mentioning emanate from our old friend, Mr. Charles A. Clark.

I should like at the outset of this paper to tender my thanks to Mr. Clark for many valuable hints and kindly assistance.

That jaw radiography has only been studied within the last few years is evidenced by the following extract from a "Manual of Practical X-ray Work," published in 1909. "By the use of films placed inside the mouth is avoided the superposition of the opposite jaw, which would be inevitable on a plate held outside the mouth on the opposite side to the tube." In a later text book, appearing in 1912, it is stated that the method of taking radiographs on plates placed outside the mouth is of limited value; only the teeth at the back of the mouth can be clearly seen, and unless the radiogram is taken obliquely the superimposed shadow of the opposite side of the jaw through which the rays must pass gives a most confusing picture.

That superposition of the opposite is not now inevitable on a plate held outside the mouth on the opposite side to the tube, and that it is possible to show clearly, not only the teeth at the back of the mouth, but also the premolars and the canine, is demonstrated by the skiagrams accompanying this paper.

In the more recent text books on radiography the description of the methods used is more adequate, but is somewhat deficient in detail when dealing with the subject now under discussion.

They state, for example, that the general outline of the jaw can be obtained on plates placed on the exterior, the tube being angled to prevent the overlapping of the shadows produced by the two sides, and centred over a spot behind and below the angle of the uninjured jaw. The object of this paper is to elaborate the method described above, and to explain in more detail the necessary technique.

It has been the author's endeavour to devise a method which does not involve the use of any special apparatus other than that commonly found in every X-ray room, and by this means to bring jaw radiography within the scope of every worker.

There is no doubt that with the aid of elaborate apparatus, such as is used in Dental Hospitals, better results may be obtained, but the simple methods herein described will be found to be sufficiently adequate for most purposes, and can be carried out without the addition of any expensive or cumbersome apparatus.

Any modern X-ray installation will suffice, but the more powerful the better, since to obtain sharp pictures full of detail short exposures are necessary.

With plates outside the mouth the following views of the jaws may be taken:

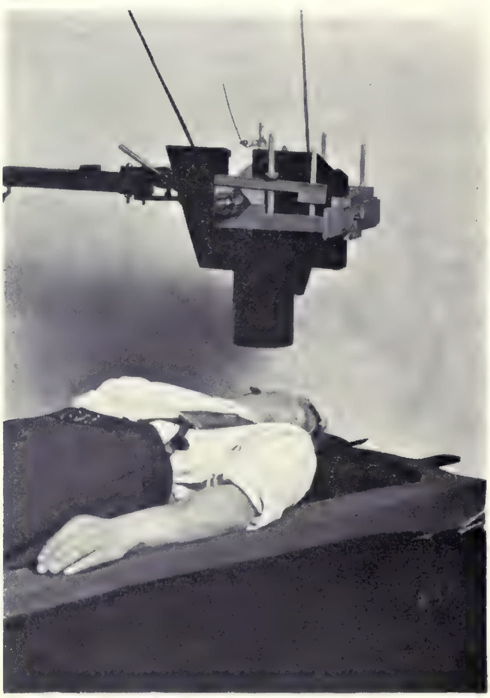
(1) Antero-posterior.
(2) Lateral.
(3) Lateral Oblique.
(4) Stereoscopic.

It will be occasionally necessary to take each one of these views in a case requiring a full investigation, but the lateral oblique view will, as a rule, be found to be the most serviceable.

(1) *Antero-posterior View.*—The patient should lie on the back on the X-ray couch, a small sand bag being placed underneath the head just above the occipital protruberance, so as to tilt the chin downwards and backwards. This enables the full length of the rami to be radiographed without the superposition of the mastoid or the zygomatic processes. The head should be placed in as straight a position as possible with the nose pointing vertically upwards.

Position of the Tube.—This should be underneath the couch.

(1) Position of patient and tube for taking left lateral oblique view.



(2) Position of patient and tube for taking a view of the left condyle.

Screening.—The fluorescent screen should be supported on two adjustable supports, such as those described by Dr. Finzi and the author in the "Journal of the Röntgen Society" of April, 1916.

The screen should be lowered so as to exert a moderate amount of pressure on the patient's nose.

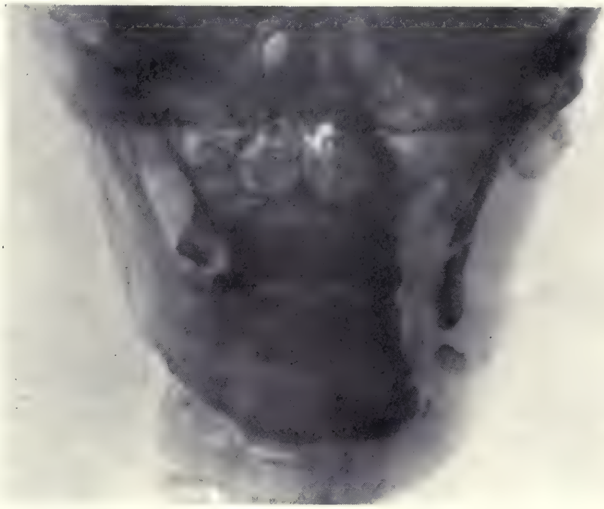
The central ray should pass through the floor of the nose, and the diaphragm of the tube box should be opened so as to cover an area slightly larger than the size of the plate to be used.

The patient's head should be adjusted until the nasal septum is seen to be central and the rami to be clear of any other bony shadows nearly to the condyles.

Radiography.—Remove the screen, place the plate in position with the

film side next to the face, and replace the screen so as to hold the plate firmly in position. The exposure may now be made.

The antero-posterior view is useful to show fractures or disease of the maxillæ, the condition of the maxillary antra, fractures or disease of the rami,



(3) Fracture of the Left Ramus. Antero-posterior view.

of the angles, and of the canine and incisor regions. It is also essential in the localisation of foreign bodies.

(2) *Lateral View.*

Position of Patient.—The patient should lie on the back on the couch, and

(4) Fracture of incisor region. Left side of Mandible.

the head should be placed laterally, with the side under observation uppermost.

Position of Tube.—This should be underneath the couch.

Screening.—This should be carried out with the supports mentioned above, care being taken to secure the exact lateral position as indicated by

the entire superposition of the two sides of the mandible. The central ray should pass through the foreign body to be localised.

Radiography.—This should be carried out as described above. The lateral view is only useful to indicate the position of a foreign body, and has no other value.

(5) Comminuted Fracture of Left Mandible. Tooth in Fracture.

(3) *The Lateral Oblique View.*—Right or left.

(*a*) *For the molar to the incisor region.*

Position of Patient.—The patient should lie on the couch on the shoulder corresponding to the side under observation.

(6) Comminuted Fracture of Mandible. Right Side. Premolar Tooth in Fracture.

Position of Plate.—The X-ray plate is placed on the couch at an angle of about 45°, with the film surface uppermost, supported by sand bags. The patient's head is gradually lowered until the angle of the mandible on the injured side is touching the plate.

The chin is then tilted vertically downwards so as to nearly touch the plate. The head is fixed in this position with sand bags placed behind the head.

Position of Tube.—The tube is placed in an easily adjustable and movable tube stand, and is used above the couch.

The tube holder is tilted at an angle of 45° with the horizontal, and the tube stand is placed on the side of the couch towards which the back of the patient is pointing.

The tube holder is then adjusted so that the central ray will strike a point half an inch below and behind the angle of the jaw on the side not under observation, and this ray should be directed as far as possible at an angle of 45° with the side of the couch.

This entails the tube stand being so placed that the ray passes just above the patient's shoulder which is uppermost.

(7) Buried Premolar tooth. Left Mandible.

The distance between the anticathode and the plate should be about 28 inches.

(*b*) *For the angle of the Mandible, the Ramus and Condyle.*

Position of Patient.—The patient should lie on the back.

Position of Plate.—The plate should be placed on the couch with the film surface uppermost at an angle of 25°, supported by a sand bag.

The patient's head is turned laterally, so that the angle of the mandible on the side under observation is touching the plate. The chin is then tilted upwards towards the forehead so as to avoid the superposition of the angle and spine.

Position of Tube.—The tube is placed in a tube stand, and used above the couch. The tube holder is adjusted so that the rays will pass vertically downwards.

The central ray should pass through a point half an inch behind and below the angle of the mandible on the side not under observation, and be directed vertically downwards.

By the above method a view of the angle, of the posterior border of the ramus, and the condyle can be obtained free from any other shadow.

Method *b* is applicable in cases where method *a* fails to show the angle and ramus sufficiently distinctly.

(4) *Stereoscopic View.*—This may be either (*a*) Lateral, or (*b*) Lateral Oblique.

The Lateral Stereoscopic View is useful when determining the position of a foreign body.

The technique is similar to that of the lateral view described above, with the exception that two views are taken, the tube being moved six centimetres between the two exposures.

A wooden frame fitted with cross wires will be found to be useful to hold the plate, and to enable the second plate to be placed in exactly the same position as the first.

(8) A Bone Graft. (Rib).

The Lateral Oblique Stereoscopic View is useful to determine the relation of the fragments to each other.

The technique differs from that of the lateral in that the head of the patient is inclined laterally at an angle of about 45°, the side under observation being placed uppermost.

The fluorescent screen and the wooden frame with cross wires should be supported by two adjustable supports, one of which will be lower than the other, so as to support the screen at an angle.

With plates inside the mouth, views of the incisor and canine regions may be taken, and with films inside the mouth any desired area may be separately radiographed.

It is not, however, proposed to discuss methods with regard to these views, as they have been adequately described by others in previous papers of recent date.

A SKETCH OF THE HISTORY OF ELECTROTHERAPY.

By Hector A. Colwell, M.B., D.P.H.

II.

(*Continued from* p. 305, Vol. XX.)

In the earlier history of the development of electrotherapy, records of animal experiments—apart from the empirical treatment of human beings—are relatively few. In the great majority of cases such experiments consisted in killing an animal by means of a shock from a battery of Leyden jars, and then making a *post-mortem* of the remains.

Priestley gives details of some of his own experiments; the animals experimented upon varied from a small field mouse to a good-sized dog. The mouse was killed by a discharge from a battery with a coated surface of thirty-six square feet; the dog received the shock from a battery with sixty-two square feet, coated, it was not however killed outright, but knocked senseless and blinded.

The phenomenon of muscular contraction, as the result of electrical stimulation, was first noticed by Jallabert, of Geneva, in 1748. When engaged in drawing sparks from an electrified human subject, he noticed spasmodic contractions of the muscles underlying the part experimented on. The contraction of an isolated muscle, as the result of the electric stimulus, was noticed by Beccaria about 1758. In this case, one of the thigh muscles of a living cock was exposed and separated; upon electric stimulation strong contractions were observed. Beccaria noted that these contractions were more marked than those arising as the result of other stimuli, such as pricking, or pinching the muscle.

About the middle of the eighteenth century medical electricity, for a time at least, enjoyed such advantages as may accrue from royal and other distinguished patronage. Not only royal physicians, but dukes, cardinals, and governors were all busy investigating reports of cures by the new therapeutic agent. Some cases, in which these aristocratic amateurs are called in as witnesses to the accuracy of the medical reports, form curious reading and are thoroughly characteristic of the eighteenth century. One eminent physician cites the Duc de Richelieu as a witness of his veracity; another is not satisfied till he has quoted the approval of Cardinal des Lances, a third invokes Cardinal Doria, while the Italian physician, Bianchini, in a letter to the Abbé Nollet, congratulates the Frenchman on being the subject of a great king who has at heart the welfare of science. The "great king" was Louis XV, who thus appears in a new rôle as a patron of anything but women, wine, and hunting.

Many will be surprised to hear that the French revolutionary, Marat, was a practitioner of electrotherapy. This extraordinary individual, who held

among other medical qualifications the degree of M.D., St. Andrews, resided and practised in London for a time. During his stay he seems to have been well received in the best scientific circles, and was the author of several treatises upon medical and physical subjects; among his works is one upon the employment of electricity in medicine. Marat subsequently returned to France and became physician to the bodyguard of the Comte d'Artois. His career subsequently to the year 1789 is only too well known, and as Mr. Wallis says, in his paper on Marat,* "It would appear that Marat had two personalities: (1) The one that of a scientist and philosopher, which died in 1789, the year of the fall of the Bastille; (2) the other, that of a fanatical journalist, pamphleteer, and demagogue." According to the latest researches the career of Marat in England would appear to have been a strictly honourable one, and his scientific works seem to have commanded a respect to which they were fully entitled. In some of the earlier English accounts of Marat he was confounded with another, of the same or similar name, and who obtained a certain degree of notoriety from his inability to discriminate nicely between *meum* and *tuum*. The name of Jean Paul Marat has a sufficient load of infamy to bear without the addition of petty larceny.

In the "History of Electricity," Priestley refers to the fact that "electricity is now become a considerable article in the materia medica." The closing years of the eighteenth century witnessed discoveries which were ultimately to revolutionize not only electrotherapy, but the science of electricity itself.

In 1791 Galvani, professor of anatomy at Bologna, noticed that the limbs of a freshly killed frog, when placed close to the prime conductor of an electrical machine, were thrown into violent convulsions. Further investigations showed that the leg of the frog, with its attached nerve, formed a delicate indicator for the presence of electricity, more delicate, indeed, than the Bennet's gold-leaf electrometer, which was at that time the most sensitive piece of apparatus known for the purpose.

Desiring to make some observations upon atmospheric electricity, Galvani made use of his newly found indicator, and suspended a number of such prepared frog legs, with their attached nerves, from an iron railing by means of metal hooks. He was surprised to find that marked contractions occurred, even when there was no evidence of any abnormal electrical atmospheric condition. Further investigations showed that the source of stimulation lay, not in the atmospheric electricity, but in the junction of two dissimilar metals suitably disposed as regards the nerve attached to the frog's leg: a more extended series of researches upon similar lines led Galvani to the conclusion that the most powerful contractions were excited by a combination of zinc and silver. Galvani himself was led to an erroneous interpretation as to the result of his experiments, since he regarded the animal body as the source of the electricity, and conceived that the metals only served to discharge it, in the same way as a Leyden jar is discharged.

* Proc. Roy. Soc. Med., Vol. ix., 1916.

The publication of these experiments of course set a number of observers to work upon similar lines. Fowler, in 1793, published an "Essay on Animal Electricity," which contains many ingenious observations, though here again the observer was led to erroneous deductions; he recognised the necessity for the employment of two dissimilar metals, and described the sensation of light when such a metallic couple is suitably applied to the eyeball, but he could not bring himself to the conclusion that electricity was at the root of the matter. Some years previously a German observer, Sulzer, noticed that when two dissimilar metals were placed upon the tongue and themselves placed in contact, that a peculiar sensation of taste resulted; Sulzer attributed the sensation to a species of vibration set up in the metals and communicated to the tongue. About the same time Professor Robison performed a series of experiments upon the effects of metallic couples upon the senses of sight and taste, making special note of the effect of applying the tongue to the edges of a number of superimposed discs of silver and zinc.

The true explanation of these various phenomena was given by Volta, of Pavia, and was communicated by him to the Royal Society in 1793. He emphasized the necessity for a pair of dissimilar metals, and regarded the neuro-muscular manifestations as due to electricity produced by their contact. In 1799 Fabroni, of Florence, made some observations upon certain chemical phenomena and noted their connection with electrical or—as they were then called—galvanic influences. Thus, when certain metals were placed in contact in the presence of moist air, he found that oxidation occurred more rapidly than when they were separated, and drew attention to the instances of copper roofs when soldered with another metal, and to the copper sheathing of ships' bottoms when fastened with iron nails.

From the foregoing facts it will be seen that events were rapidly shaping themselves in preparation for the discovery of some form of electric cell whose energy was derived from chemical action.

In the year 1800, exactly two hundred years after the publication of Gilbert's masterpiece, Volta announced his discovery of the piece of apparatus which bears his name—the Voltaic Pile.

We have seen that Volta considered that two dissimilar metals placed in contact were capable, under suitable conditions, of producing electricity; he next conceived the idea of using a number of such metallic couples, and so producing a cumulative effect. The first apparatus constructed for this purpose consisted of a pile of silver coins and zinc discs, each pair being separated from its neighbours by a piece of card soaked in water; on simultaneously touching the two ends of the pile a distinct shock was experienced. Volta soon followed the construction of the Pile by the experiment known as the "Couronne de tasses," in which a number of small glasses were filled with some saline solution, and placed side by side; a number of pairs of strips of zinc and copper, or zinc and silver, were joined together by wires, and placed in the glasses in such a way that the zinc of one couple was in one glass, while the corresponding copper dipped into its neighbour. A number of these zinc-

copper combinations being arranged as described, a system was produced which possessed properties identical with those of the Voltaic Pile.

Volta's own experiments with his primitive electric battery were exclusively confined to the animal body; but as soon as his work was published a number of other investigators interested themselves in the new phenomena. Volta himself had concluded that since his pile was capable of giving a shock, it was a source of electricity. Nicholson and Carlisle not only incontestably proved the presence of electricity, but demonstrated the different electrical conditions of the two ends of the pile. About the same time (1803), Cruickshanks modified the "*Couronne de tasses*" by placing the pairs of plates in a trough and suitably connecting them. Sir Humphrey Davy demonstrated that pure water was useless as the liquid part of the system, as was also pure sulphuric acid—observations which have only received their full explanation in our own time, when it is known that the essential character of the solution employed is that it contains a suitable dissociated electrolyte.

The chemical side of the question was investigated by Wollaston and others; but in spite of accumulating evidence as to the importance of chemical changes, Volta persisted in his opinion that the sole source of the electricity lay in the simple contact of two dissimilar metals, and that the fluid merely served to convey electricity from one pair of plates to another. Indeed, Volta himself does not seem to have participated in any of the discoveries that were made by means of his apparatus; he apparently occupied himself exclusively in experimental work which he regarded as upholding his hypothesis of its mode of action.

Animal experiments, apart from Galvani's original experiment, had been performed upon invertebrate animals as early as 1793, by Fowler, who placed worms and other small creatures in contact with metallic couples, and recorded various forms of response to the stimulus. Experiments upon warm-blooded animals were of later development. Creve, of Wurzburg, produced contractions in a freshly amputated human leg; Vassali-Eandi, with his co-workers, Giulio and Rossi, carried out a series of experiments upon decapitated criminals at Turin. In this latter case attention was specially directed to the heart and other involuntary muscles, especially those of the stomach and intestine. Volta had asserted that the involuntary muscles were unaffected by his apparatus, a position which was controverted by Fowler. The conclusions of the Italian observers supported Fowler in maintaining that the involuntary muscles were affected.

In 1803, Aldini, professor of Natural Philosophy at Bologna, published a treatise on "Galvanism"; among other experiments recorded therein was one in which he applied the terminals of a powerful battery to the body of a criminal hanged at Newgate, and recorded extraordinary convulsions and facial contortions as a consequence of the stimulation.

About the same time (1803) the therapeutic effects of galvanic electricity began to have a considerable trial, especially in such types of case as had been found to derive benefit from frictional electricity. As is usual with new

remedies, grossly exaggerated accounts of its beneficial effects were circulated, with the inevitable result of bringing it into disrepute. It had been vaunted almost as a specific in "different nervous disorders, in paralytic affections, in deafness, in some kinds of blindness, in the recovery of the suffocated and drowned, and even in hydrophobia and insanity." * For some years accordingly the use of galvanism fell into abeyance, until, in 1817, Dr. Philip, of Worcester, revived it as a treatment for spasmodic asthma. In his communication to the Royal Society, Philip describes the method of application, and deprecates the irresponsible accounts which led to the discontinuance of what he regarded as a useful therapeutic agent. Among the many things galvanism was supposed to effect were the restoration of sight, hearing, and voluntary power!

The battery employed by Philip consisted of from eight to sixteen plates of copper and zinc, each four inches square; these were immersed in a trough containing a mixture of one part hydrochloric acid to twenty parts of water; as electrodes, he employed two thin plates of metal about two or three inches in diameter; these were dipped in water, and one was applied to the nape of the neck while the other was in contact with the pit of the stomach. The application was continued until the patient said his breathing was easier; the length of exposure varied, sometimes from fifteen to twenty minutes were required. As a general rule the treatment was to give a daily sitting of ten minutes over a period of eight or ten days.

In the earlier decades of the nineteenth century the work of Faraday upon electro-magnetic induction paved the way for the construction of the induction coil. It was in 1831 that he made the discovery of magneto electricity.

Two wires overspun with silk were wound side by side over the same wooden cylinder. The two ends of one of the wires were connected with a voltaic battery, and the two ends of the other with a galvanometer. Faraday found that no matter how powerful he made his currents in the one wire the other wire remained absolutely quiescent while the electricity was flowing through its neighbour. The attention of the keen-eyed experimenter was, however, soon excited by a small motion of his galvanometer needle, which occurred at the moment the current from the battery first started through its wire. After this slight impulse the needle came to rest, but on interrupting the battery current another feeble motion was observed opposite in direction to the former one. The momentary currents thus generated he called induction currents.

Du Bois Reymond tetanized muscle by interruption, make and break.

Electrotherapy in its modern sense dates from 1847, and owes its inception to Duchenne. Duchenne's essential discovery was that individual muscles are capable of electrical stimulation by the application of electrodes to the overlying skin. Previously to his work, muscular contractions had, of course, been noted as the result of electric shock, and in animal experiments muscles had been exposed by incision and then stimulated; the second of these methods

* Bostock: "An Account of the History and Present State of Galvanism." London: 1818.

is manifestly impossible as a routine treatment in the human subject, while the general muscular twitching, as the result of an electric shock, is too diffuse to give any exact information as to the condition of muscle or nerve; and it must be remembered that the diagnostic side is of the highest importance in electrotherapy. Until Duchenne took up his work in Paris, all impairments of movement were included, in the Paris Hospitals, under the term "Paralysis"; their pathology was unknown, and the unfortunate sufferers were apparently regarded as hopeless chronic invalids of a most uninteresting character. The term paralysis, indeed, had simply become a kind of diagnostic dust-heap for accumulated ignorance, and it is necessary to appreciate this fact in order to understand the opposition which Duchenne encountered from his professional brethren in Paris.

Duchenne was born at Boulogne in 1806, his father was a sailor, and he

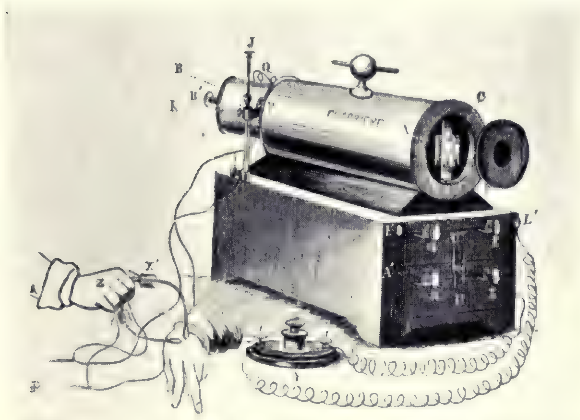


Fig. 2 bis Appareil volta-faradique à double courant du docteur Duchenne (de Boulogne).

himself was originally designed for a seafaring life; while at school, however, he developed a taste for science, and eventually adopted medicine as a career. After qualifying, he worked in Boulogne for eleven years, and in 1842 migrated to Paris, where the great hospitals afforded him abundant material for his researches. He chose the "paralytics" as the subject of his investigations, and soon established essential differences in the various disorders which were associated with loss of movement. Many cases classified as hopelessly incurable recovered the use of their limbs, and, to the surprise of the physicians, were found walking about the wards.

Duchenne's personal manner was not calculated to minimize hostility; he had much of the taciturnity and brusqueness which is associated with certain traditional types of sailor, to which in appearance he bore a marked resemblance. Accordingly, in his own country, he long remained a comparatively little known man, though he spent an enormous amount of time in the hospitals, and,

moreover, contributed to the "Revue Médicale" and to the various foreign journals. Trousseau endeavoured to overcome the effects of Duchenne's inability to express himself clearly and concisely at meetings of the various societies, and may be said to have acted as his interpreter. Duchenne himself embodied a large amount of his work in his treatise, "De l'electrisation localisée," from the frontispiece of which our illustration is taken. Among the subjects which specially occupied his attention were anterior poliomyelitis, which, in 1855, he concluded was due to some lesion of the anterior cornua of the grey matter of the spinal cord, progressive muscular atrophy, and locomotor ataxy, of which last disease he noted the syphilitic origin. Hardly anything was known of the personal history of Duchenne until Dr. Collins* gleaned such information as was obtainable from those who knew him, and from his grandnephew. It is not often that a distinguished scientist, who died so recently as 1875, has left behind him so few personal details as the founder of modern electrotherapy.

After the ground had been broken by Duchenne, the diagnostic and therapeutic uses of electricity became widely extended, largely by the labours of such men as Remak, Ziemssen, and Erb; while Addison and Gull, working at Guy's Hospital, again employed static electricity in the treatment of nervous disorders.

Although we have only touched the fringe of the history of electrotherapy, we must, for the time at least, take our leave of the subject. Its modern developments have been so considerable, especially in the direction of accurate standardization of apparatus and dosage, that even an epitome of the subject cannot be here attempted; in particular, the subject of radiotherapy has accumulated such a vast amount of literature, both from the experimental and the clinical aspect, that anything like a complete account of it would fill a fair-sized volume.

In conclusion, we beg the reader's indulgence for such errors as may have crept in, and for many doubtless glaring omissions. We only urge in extenuation that this second part was written only with the aid of some rough notes, far away from England and from libraries or books of reference.

(The appreciation of Dr. Colwell's concluding article by our readers will not be lessened by a fuller reading of his final paragraph. Amid the incessant booming of the guns the article has been finished, an effort which cannot be passed by without this, the smallest recognition.)—S. R.

* Collins: *New York Medical Record*, 1908, Vol. 73, p. 50.

THE USE OF REPEATED X-RAY EXAMINATIONS FOR OBSERVING THE PROGRESS IN CASES OF OSTEOMYELITIS.

By R. W. A. Salmond, M.D., Ch.M.

Paper read before the Electrotherapeutic Section, Royal Society of Medicine, Dec., 1916.

The following description is that of two essentially different types of osteomyelitis of the radius, in which radiographic examinations were made at successive intervals to show the course of events taking place in the affected bone. The main clinical facts are also given.

Case I.—L.B., age 9. Infective osteomyelitis of staphylococcic origin.

Patient was brought to O.P. Department suffering from pain in the right forearm, with the history that she was knocked down, and fell, with her right arm under her, in the school playground on the previous afternoon, and had complained of pain in it the same evening. Her mother is quite definite that when she went to school that morning her forearm was quite right. A radiograph (Fig. 1) taken on this date shows practically no change in the bone except, perhaps, a very small area of slight rarefaction at the outer side of radius at its lower epiphysial line. The next day she was admitted to hospital, under the care of Mr. S. J. Wareham, with a temperature of 100°, and the forearm treated with fomentations. The following day the forearm showed a condition of general cellulitis—under an anæsthetic three long incisions were made down to the bone, and pus evacuated.

Eight days after this the temperature had dropped to normal, and remained so until the relapse three and a half years later.

One month from the onset another examination (Fig. 2) was made, and the lower end of radius seen to be largely disorganised. Here necrosis is seen alongside partially destroyed bone. There is a sharp line of differentiation between the affected and unaffected portions of the shaft. New bone is being deposited by the separated periosteum, and can be seen along the whole length of inner side of radius. The upper part of radius is also affected, but to a somewhat less degree. Beneath the separated periosteum the cortex of the shaft is seen to first become eroded and be made irregular, and ultimately to disappear.

One month later (two months from onset), examination (Fig. 3) shows an extension of all the appearances of last month. The newly deposited periosteal bone formation has increased in width and density and become more regular in outline. Its width on either side of the shaft equals that of the original shaft, the whole of which is now surrounded, except at the middle third of outer side. Abscess cavities are seen at both upper and lower ends of the bone. On this date an incision on outer aspect again struck pus.

One month later (three months after onset), (Fig. 4). The original shaft has now been almost entirely absorbed. The newly deposited bone has

formed a new wavy outlined and widened one, with slight traces of the original shaft to be seen at the upper end. There is an abscess cavity at the lower end involving also the epiphysis and containing a sequestrum. The carpal bones are not affected, nor is the upper epiphysis. A drainage tube is present about the middle of the shaft and points towards a sequestrum. Slight periostitis of the posterior aspect of the ulna was observed in the lateral view.

Next month (four months after onset), the radiographic appearance (Fig. 5) is rather more quiescent than in previous month. The width of new shaft is slightly less, and a piece of the shaft has been removed in an intervening operation. At least three sequestra are to be seen, one in the abscess cavity at upper end, another in the middle of shaft, and a third in process of extrusion from the abscess cavity at lower end. The upper epiphysis remains unaffected.

Next month (five months after onset) the examination (Fig. 6) showed that the sequestrum seen last month in upper abscess cavity has been discharged. Others are still present. On the whole, however, there is little change.

Shortly after this examination, a note says that three small sinuses are still present over lower half of radius, with the remains of a healed sinus near the elbow joint. Patient was now sent to a convalescent home at Reigate.

She remained there for three months and then returned with a healed forearm, and an examination (nine months after onset) (Fig. 7) showed considerable change from previous plate. The new shaft has a much more solid look, its width has returned to more normal size, its trabeculæ have a more normal appearance, and its outline is more regular. The upper abscess cavity has largely filled in, but not the lower one. Upper epiphysis has remained unaffected.

Two months after this (eleven months after onset) (Fig. 8) there was found to be new periosteal bone deposition in upper third of the bone, with an area of rarefaction in its interior. This was interpreted as a slight recrudescence of the disease, and if so, is interesting, as it caused no subjective symptoms whatever, and by the fact that some two years later a definite recurrence, with abscess formation, took place at this same position.

Three months after last examination (fourteen months after onset) (Fig. 9) the recrudescence has quietened down, without any sequestrum having been formed, but the area of rarefaction still remains. The shaft is more normal in width though the cavity at lower end is still unobliterated.

Six months later (twenty months after onset) an examination showed the lower abscess cavity to be rather less, but still unobliterated. The upper rarefied area has disappeared.

Three months later (twenty-three months after onset) (Fig. 10) the lower cavity is still unobliterated.

For the next ten months I unfortunately lost touch with the case, as the war had started and duties kept me away from London, but at the end of this time, that is, thirty-three months after onset, an abscess had developed at the


Fig. 1 (24 hours)


Fig. 2 (1 month)

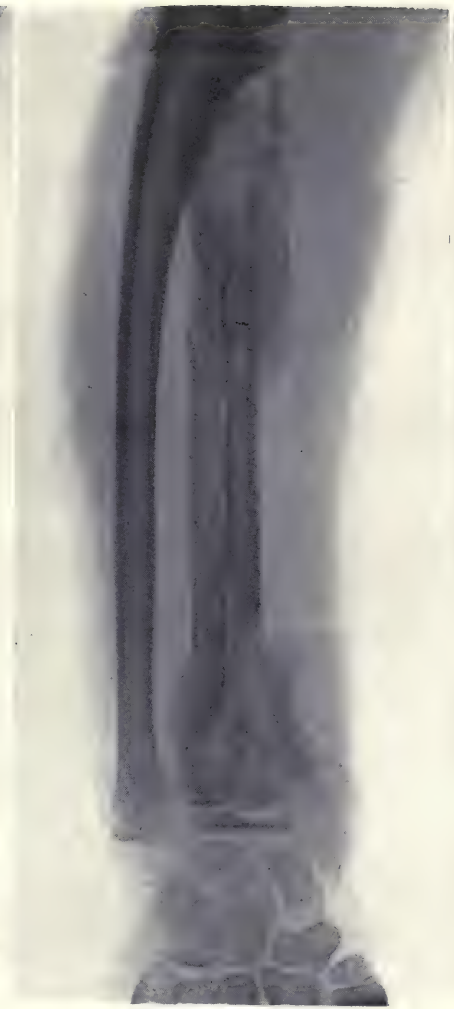


Fig. 3 (2 months)


Fig. 4 (3 months)

PLATE 25

CASE 1.—Infective Osteomyelitis of Staphylococcic Origin.

Fig. 5 (4 months)

Fig. 6 (5 months)

Fig. 7 (9 months)

Fig. 8 (11 months)

PLATE 26

CASE 1.—Infective Osteomyelitis of Staphylococcic Origin.

Fig. 9 (14 months)

Fig. 10 (23 months)

Fig. 11 (33 months)

Fig. 12 (49 months)

Fig. 13 (54 months)

PLATE 27 CASE 1.—Infective Osteomyelitis of Staphylococcic Origin.

Fig. 14

Fig. 15

Fig. 16

Fig. 17

PLATE 28

CASE 2—Syphilitic Osteomyelitis.

wrist, and on examination (Fig. 11) the lower abscess cavity was found to be still unobliterated, and marked swelling of the soft parts over it corresponding to the pointing of the abscess.

Eight months afterwards, and while I was away again, she was readmitted to hospital, now three and a half years from the onset, with a temperature of 102°. Part of the shaft of radius and some sequestra were removed by operation, and at the end of four months she left with a forearm healed again

Four months afterwards (forty-nine months from onset), an examination (Fig. 12) showed the lower cavity had at last become obliterated, but that there had been a relapse at the upper third of the diaphysis, where the shaft is widened and the remains of an abscess cavity seen. A new shaft is in process of formation here. This corresponds to the seat of operation just mentioned, and to the place where a slight recrudescence was observed two years before. The upper epiphysis is not affected. Periostitis was observed on posterior surface of the ulna in a lateral view.

Two months later (fifty-one months after onset) the remains of upper abscess cavity was seen to be smaller and to be filling up.

Three months afterwards (four and a half years after onset) (Fig. 13) the upper cavity is almost obliterated, and the newly formed shaft again appears more normal. The lower epiphysial cartilage having been involved has apparently lost some of its bone forming functions, for the ulna is seen to be growing faster than the radius and pushing the hand into a position of slight abduction. Apart from this, the patient has a very useful forearm, with movements in every direction.

This brings the radiographic observation of this case up to the present date, and as there seems the possibility of further developments it is hoped to continue them further. The chief points of interest in this case are :—

Observations were begun within twenty-four hours of the definite exciting factor.

The clinical crisis taking place before almost any radiographic changes were to be seen.

The escape of upper epiphysis, adjacent joints, and, except for an occasional slight periostitis, the ulna.

The formation of a complete new shaft in three months. The old one meantime having been absorbed, detached as sequestra, or removed at operation.

The occurrence of two relapses, one causing no symptoms and found quite unexpectedly, the other, some two years later, at the same position much more acute.

The unobliteration of one of the abscess cavities in the bone for three years. This seems due to the remains of some focus of disease, as the subsequent extrusion of a sequestrum, or pus, or both, led to its disappearance.

X-ray examinations, as just illustrated, present a pathological record of the course of destruction and reconstruction of the bone in such a disease unobtainable in any other way.

Case II.—N. A., age 13. Syphilitic Osteomyelitis.

6th June. Patient was admitted to hospital, also under Mr. Wareham, with the history that a swelling had been coming on the outside of right knee for the last three years, with other swellings on right forearm and cheek of more recent date. On examination, the lower end of femur was found to be practically fractured and in bad position. There were also gummata to be felt on the forearm and cheek. Definite signs of syphilis were present in the teeth, eyes, and frontal region. Temperature subnormal. X-ray examination (Fig. 14) shows a definite osteitis and periostitis of the upper two-thirds of shaft of radius, with disappearance of the cortex, the upper epiphysis being also affected. Treatment: Pot. Iodide, 30 grs. and Pil. Hydrarg. 8 grs. per diem.

14th June. An X-ray examination showed no change.

18th June. The gummatous deposits are smaller and much less inflamed.

28th June. An X-ray examination (three weeks after anti-syphilitic treatment) shows very little, if any, improvement. Pot. Iodide is now increased to 45 grs. per diem.

12th July. Iodide of Pot. is being well tolerated, and the gummatous deposits in forearm and cheek are slowly diminishing in size.

An X-ray examination (five weeks after commencement of treatment) (Fig. 15) shows a slight improvement.

31st July. Discharged as O.P. and to continue mercury and iodide treatment.

16th August. X-ray examination (ten weeks after commencement of treatment) (Fig. 16) shows more definite improvement, the periosteal thickening having been largely absorbed.

27th November. Another examination (nearly six months after commencement of treatment) (Fig. 17) shows a marked improvement. The periosteal thickening has been almost entirely absorbed, while the trabeculæ have a nearly normal appearance and the cortex has been reformed.

Clinically, no trace of any gummata could be felt in the forearm, which seemed quite normal.

This was a case of bone infection, undoubtedly syphilitic in nature, and while it does not show the appearances from the start, as in the former case, it shows the effects of mercury and iodide on one of the affected long bones. Under this treatment the bone showed little improvement radiographically until about two months, when the condition gradually returned to normal. As in the previous case, the adjacent joints were not involved, and the clinical improvement took place long before the radiographic.

The notes of these cases show, I think, the value of repeated and systematic X-ray examination for recording the course of changes taking place and even helping to form the prognosis, and, in conclusion, I wish to thank Mr. S. J. Wareham for the clinical notes and for his ever ready co-operation in these observations.

REPORT OF SOCIETY.

RÖNTGEN SOCIETY.

At the January meeting of the Röntgen Society, Mr. C. A. Schunck, F.C.S., gave an account of some spectroscopic investigations of sources of ultra-violet radiation in relation to the treatment by ultra-violet rays. He described the ultra-violet radiation as extending from 3,934 to 1,850 Angström units, being followed by the Schumann region from 1,850 to 1,230, and said that the tungsten arc was the most efficient source clinically for ultra-violet radiation as judged by the erythema effect. The region of the spectrum with the most effective radiation from this point of view was that between 2,100 and 2,960. Major W. J. Turrell, with whom Mr. Schunck has been collaborating at Oxford, said that the great difficulty so far as the use of the tungsten arc was concerned was the impossibility of getting a sufficient supply of tungsten at a price that was not prohibitive. At the present time there was a very large quantity of tungsten available, enough to supply all the needs of the medical profession. Nevertheless, it was almost impossible to obtain tungsten for medical purposes. All he could get was the pure tungsten, which cost about four guineas a pound. Metallic tungsten for military purposes, however, if bought by the ton, cost six shillings a pound, and if bought by the pound, six and threepence. He wrote several letters to the Minister of Munitions in order to obtain it at this figure for the civil hospitals, but without getting any concession, and he thought that if the medical societies took up the matter of the supply of tungsten it might be of some advantage. Until a supply was assured, one could not expect instrument makers to go to the trouble of designing and manufacturing lamps for the supply of ultra-violet radiation. As to treatment, he found this of therapeutic use in eczema and in Raynaud's disease, and he thought that a small enclosed lamp, with an opening in which a condenser could be fitted or not as required, and taking four or five ampères of current, would find a very wide sphere of usefulness in the treatment of wounded soldiers. Major Robert Wilson described his lamp, consisting of one tungsten electrode and the other electrode of carbon cored with tungsten, which, he said, gave a very good light, and enabled one to obtain an erythema in three minutes. In certain types of suppurating foul wounds, treatment by this means did clear up the condition. Mr. J. H. Gardiner thought that the difficulty with regard to tungsten should not discourage investigation, for iron would do a very great deal, furnishing a useful spectrum. There was no question as to the advantage and utility of ultra-violet radiations for a good many purposes, but the problem which medical men must solve was as to the kind and wave-length of radiation which produced the effects they wanted. Dr. Sidney Russ disputed Mr. Schunck's contention that the main therapeutic effects were to be associated with the small range of wave-lengths which produced the erythema. If these rays were cut off—as they were by the thinnest layer of skin 0.1 mm. or so in thickness—no erythema was obtained, but he thought that there was a possibility of physiological action proceeding at a depth owing to the stimulus on the surface, and, furthermore, it did not follow that if this radiation were not allowed to enter the other radiation outside these limits had no physiological effect. Mr. Schunck, in reply to the last speaker, said that the medical side of the question was not his province. His therapeutic experiments were based upon the erythema effect alone, and the other effect, or the question as to what really was the cause of the improvement, was a matter with which he could not deal.

Dr. G. B. Batten showed a small cross-wire frame for use in localization. It was an arrangement in which the wires were adjustable, and this he thought had the advantage in localising a bullet situated in such a position as the outer part of the thigh, where, with a

frame in which the cross wires were fixed to intersect in the middle, a good bit of the plate was necessarily wasted in centreing. Another advantage was that the wires could be laid directly on the patient and inked with Indian ink. Captain Finzi said that cardboard, which was used for this frame, was scarcely sufficiently rigid, metallic work being better; movable wires also had the disadvantage that one tended to get them out of the right angle.

REVIEW.

Skin Cancer. By HENRY H. HAZEN, A.B., M.D. C. V. Mosby Company. St. Louis. 1916.

In this little volume the author mentions all the better known tumours of the skin, both benign and malignant, so that the ground covered is somewhat more extensive than the title of the book implies. Unfortunately, in a work of this size and purpose, there must necessarily be a considerable variation in the detailed description of the various lesions, and this varying completeness is the disappointing feature of the book which in many points is quite admirable. The better chapters are those on the subjects of the precancerous dermatoses, rodent ulcer, multiple benign tumours, nævocarcinomata and the sarcomata and sarcoids, while that on the lymphomata, including mycosis fungoides, conveys but little positive information. Treatment is summarised in one chapter, which is well divided. The section dealing with radiotherapeutics is distinctly disappointing. Consisting largely of quotations from other authors, it appears to lack much detailed description from the writer's own experience. He prefers the method of applying a few massive doses—controlled by the Holzknecht radiometer—to that of frequently repeated short applications of X rays. With regard to radium, while admitting that it can do great good, the author maintains an attitude of great scepticism. The illustrations throughout the book are many and clear. W. I. O.

NOTES AND ABSTRACTS.

RADIOGRAPHY.

Roentgenography in the Localization of Brain Tumour, Based upon a Series of One Hundred Consecutive Cases. — GEORGE J. HEUER and WALTER E. DANDY (*Bulletin of the Johns Hopkins Hospital*, Vol. XXVI, No. 309, p. 311). Radiographs by Drs. Baetjer and Waters.—This most important contribution to a very difficult subject should be seen, and studied carefully, by all roentgenologists, as it is the most comprehensive and valuable paper which has up to the present been published on a very obscure and difficult X-ray problem. The clinical, operative, and post-mortem findings are contrasted with the X-ray appearances, and the exact relationship of the latter to the former in the matter of diagnosis are clearly indicated. One exceedingly important point is fully demonstrated. Calcification may take place in normal structures. Thus, radiograms are reproduced showing definite shadows in the pineal gland, the choroid plexus, and the falx cerebri; all these give very dense, clearly marked shadows, and, unless the radiologist is aware of these possibilities, X-ray errors of diagnosis are clearly possible. One remarkable case of calcareous deposit in a large aneurysm of the internal carotid artery is very beautifully portrayed. The author's conclusions in full are as follows:

1. With the exception of the comparatively few which show definite tumour shadows, roentgenograms of the head are merely an aid, though an important aid, in the diagnosis of brain tumour.

2. Uncalcified tumours do not cast shadows in the roentgenogram unless tumour tissue has invaded the accessory sinuses. A possible exception may be hypophyseal lesions, which are viewed against the dark temporal fossa.

3. Calcified or bony tumours cast shadows which are readily recognised. In our experience such shadows occur in 6 per cent. of patients with brain tumour.

4. The signs in the skull of increased intracranial tension, *i.e.*, enlargement of the skull, separation of the cranial sutures, general convolutional atrophy, and destruction of the sella turcica, have a considerable value in the differentiation between cerebral and subtentorial lesions, for they indicate an internal hydrocephalus, rare in cerebral tumours, but a usual accompaniment of posterior fossa tumours.

5. The local changes in the skull due to brain tumour are of greatest value in the diagnosis of hypophyseal or suprasellar lesions.

6. Local hypertrophy of the skull over cerebral tumours is of definite diagnostic value in 4 per cent. of the cases. Local atrophy is of equal value. Local unilateral vascular changes have diagnostic significance. Local convolutional atrophy is of importance.

7. In about 45 per cent. of the cases roentgenography has been of real diagnostic value.

The radiographs illustrating the paper are very good, and side by side are untouched reproductions, and reproductions in which the diagnostic points have been intensified. The paper is of great importance and should be seen, and studied, by anyone practising as a radiologist. C. T. H.

The Value of the Lateral View of the Hip. — P. M. Hickey (*American Journal of Roentgenology*, June, 1916, p. 308).—The writer has adopted the following technique to supplement in suitable cases the usual antero-posterior view.

The patient lies upon the side to be examined, the thigh is flexed until it forms a right angle with the long axis of the body. The plate is placed under the affected side and the rays directed from above downward, with the tube in front of the patient, so that the central rays are forming an angle of 20°-25°, passing through the greater trochanter. The patient's back is supported by long sand-bags, and the patient's femur under examination is immobilised by other sand-bags. The other leg is preferably raised from the table and supported in an easy position by pillows.

This technique cannot be employed in cases where the pain or disability prevents flexion of the thigh, but it is of great value in certain cases. R. W. A. S.

RADIOLOGY.

The Physical Aspect of Roentgen-Ray Measurement and Dosage. — J. S. Shearer (*American Journal of Roentgenology*, June, 1916, p. 298).—The only accurate measure of quantity of radiation is the heat developed on complete absorption, but this does not determine the usefulness of the radiation for any particular purpose. The actual energy associated with a beam of X rays is very small, and at present we have little evidence that it is an important factor so far as therapeutics is concerned. The same amount of energy could be absorbed by tissue as heat or light without corresponding results. Yet the absorption of a given type of radiation doubtless determines its biological action. We do not know as yet the relation between the amount of radiation absorbed and the biological effect. Very probably it is not in any simple or direct proportion. All our evidence at present indicates that if there were no absorption, no biological change would result, and that rays might be of such a penetration as to have but little effect, *i.e.*, when all are absorbed before reaching a lesion, or when all pass through, giving no effect at all.

There is, however, good reason to believe that a close analogy exists between the action of the rays on the photographic plate and their biological action.

It is well worth careful study whether it is possible to sensitise tissue, either by introducing material to increase the absorption and to produce characteristic rays, or to aid in the after action of the rays by rise in temperature or by modified blood.

The author is convinced that the most reliable means of determining the amount of radiation delivered is to measure voltage, current through the tube, distance, and time.

Even with an ordinary spark-gap measure of voltage, an accuracy of reproduction can be attained quite beyond the range of variation possible of detection with pastilles or papers. The radiation from the Coolidge tube, operated under constant conditions, can be standardized for any given transformer, so that tube current, primary voltage, distance, and time will absolutely fix the radiation, and there will be no more reason for ultimately having to use pastilles or strips than to have a photometer to test one's own lamps.

Summarizing, Shearer finds that there is a very close agreement in the pastille or Kienböck readings of all types of transformer when a *reliable* voltmeter is used. While it is not safe to use spark-gap data from one machine to another unless the same type of transformer and gap is used, a machine may be calibrated with either pastilles or Kienböcks, preferably with both, so that the skin dose per minute on a given control setting, distance, and tube current may be known if the primary voltage is reasonably constant. When this is carefully done the Kienböck or pastille becomes an additional check on the total dose, or on a suitable partial dose.

The paper contains plotted charts and reproductions of exposures of the author's and other observers' physical findings.

R. W. A. S.

X-Ray Idiosyncrasy.—G. M. MacKee (*American Journal of Roentgenology*, June, 1916, p. 293).—The author states that the untoward effects of X rays have decreased in proportion to experience and improvement in technique, and that most of the former cases of radio-dermatitis were caused by errors of technique or of judgment, or of both, which were unavoidable at the time, but which are now, at least to a large extent, avoidable.

He would limit the term idiosyncrasy to a susceptibility of unknown cause, and differentiates it from susceptibility, which implies a hypersensitiveness of known or unknown cause. Many former instances of idiosyncrasy are now known to have been examples of acquired susceptibility, for we know that the application to the skin of irritating chemicals, such as iodine, chrysarobin, tar, mercury, sulphur, iodoform, etc., markedly enhances the effect of the ray.

Certain diseases may produce a hypersusceptibility on the part of the skin, for instance, the skin over goitre or mycosis fungoides, or the lesions of psoriasis or eczema.

The situation on the body is another factor, for all the flexures are more susceptible than other portions of the body. The scalp, especially the vertex, will stand larger doses than any other part so far as regards a radiodermatitis, but the author thinks it unwise to depilate a second time until the lapse of six months in order to avoid permanent alopæcia.

Aged individuals tolerate much larger doses than very young subjects. The female skin is perhaps a little more sensitive than that of the male, and very dark skins do not seem to react as readily as do the lighter complexions.

The skin that has once been treated is immediately more susceptible, and this susceptibility may last for three or four months. Again, the reaction from a treatment may be delayed. MacKee says it is much safer to allow a lapse of six or eight weeks after an erythematous dose in order to avoid the possibility of overlooking a delayed reaction, and to allow the skin to lose its acquired susceptibility before giving a second treatment.

The state of the cutaneous circulation has to do with the effect of the ray, anæmias reducing it and congestions increasing it.

A peculiar condition, which McKee calls radio-erythema persistans, is when the erythema develops in the normal time, but lasts for several weeks, or even months, instead of disappearing in a week or two.

The author concludes by saying that he has never had a case of unexpected radio-dermatitis, or an untoward result, that he did not feel was caused by an error in technique or in judgment. He does not, however, wish to be misunderstood as expressing the belief that there is no such thing as idiosyncrasy to the X-ray.

The trend of the paper is to show that many cases which were formerly believed to be due to idiosyncrasy are really due to one or other causes, which become apparent as our knowledge and technique are improved.

R. W. A. S.

The Cause and Prevention of the Constitutional Effects associated with the Massive Doses of Deep Roentgentherapy. — G. E. PFAHLER (*American Journal of Roentgenology*, June, 1916, p. 310).—The constitutional effects consist for the most part of nausea, and sometimes vomiting. The symptoms rarely appear before the patient leaves the room, but generally within half an hour to an hour, lasting only during the remainder of the day and disappearing the following morning.

Occasionally they persist over several days, and when added to by other prostrating influences have appeared to continue to a slight extent for as long as two weeks.

Associated with the nausea and vomiting there is more or less prostration, and, in a few instances, faintness. A few patients have complained of headache.

The author believes that one of the main factors causing these symptoms is the gases produced by the action of the high tension current on the air, both from the transformer and from the wires leading to the tube. To this may possibly be added the ionization effects of the rays upon the air. In addition, there must be some fitting condition of the patient which renders him sensitive to these effects, for with two patients treated in the same room, during the same length of time, one may develop symptoms and the other be absolutely free.

These symptoms seem to develop in about one-fourth of the cases treated. As to the elimination of these gases, the author advises careful insulation of every possible point of leakage, especially using heavy cables instead of wires, or by Caldwell's method of enclosing the tube in an air-tight casing with suction apparatus.

He also points out the advantage of a large well-ventilated room with considerable air space, and feels sure that careful direction of air currents and the supplying of fresh air has eliminated a great part of these constitutional effects.

Pfahler describes his mask for supplying fresh air mixed with oxygen directly to the patient. By means of valves the patient inspires the outside air through rubber tubing and expires into the room.

He also advocates dividing a large series of doses over two or three successive days.

As to the treatment of symptoms when present, the author gives a dose of aromatic spirits of ammonia immediately after the treatment, and repeats this every three or four hours as long as the symptoms last. In addition to this, if the symptoms are marked, the patient should be placed in bed or in a reclining chair in a well-ventilated room, or even out of doors. R. W. A. S.

MESSRS. WATSON & SONS (Electro-Medical), Ltd., in submitting a sample of their new introduction, "Sunic" X-ray plates, point out that the production of a suitable plate for radiography has hitherto been left in the hands of dry plate makers.

The need for considerable research and progress in this direction has long been evident, and in order to investigate the possibilities of an improvement, they persuaded a well known physicist and chemist to interest himself in the problem, and to endeavour to produce a plate which would be different from the usual X-ray plate, in that it should be produced solely with a view to giving the best result from exposure to the X rays, entirely omitting any question of, or effects obtained by, the action of light on the ordinary photographic emulsion.

The result of long, careful research has enabled them to place on the market an X-ray plate which is claimed to be a marked improvement, not only as regards speed, rapidity, and fineness of grain, but also what is of equal importance, uniformity between the various batches produced.

It is pointed out that this plate is not suitable for ordinary photography, and should be used solely for radiographic work.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

THE ROENTGEN RAYS IN THE DIAGNOSIS OF CHRONIC APPENDICITIS.*

By Roswell T. Pettit, M.D., Ottawa, Illinois.

The diagnosis of chronic appendicitis is not always an easy matter. It is common knowledge that inflammation of the appendix may give rise to symptoms referable to other organs, both intra- and extra-abdominal, and conversely, pathological conditions of the pleura, gall bladder, cæcum, kidney, spine, etc., may furnish symptoms referable to the appendix.

Everyone makes mistakes, but how many cases have we all seen where removal of the appendix has failed to relieve pain in the lower right quadrant of the abdomen? If the pain remains after operation, it is reasonable to

*Read before the North Central Illinois Medical Association, December 6th, 1916.

assume that the diagnosis was wrong, and the percentage of such mistaken diagnoses is very high.

Robert T. Morris[1] recently said, "So many ineffective appendectomies are done upon a basis of incomplete diagnosis, some of us must call a halt."

F. G. Connell,[2] in a paper before the last meeting of the American Medical Society, reports that in 212 patients operated on for chronic appendicitis, 87, or 41 per cent., were not relieved of their symptoms. Certainly this is a very high percentage of failures. He further states, "Evidence presented shows that the diagnosis is often incorrect, and is being made with unwarranted frequency. Cases characterized by more or less continuous discomfort in the right side of the abdomen, or of mild attacks of short duration with brief intervals of relief, in which the pain is made worse by exertion, . . . associated with hypersensitiveness of skin and spasm of muscle, . . . normal or subnormal temperature, no increase in leucocytes, . . . are often pseudo-appendicitis, and are not permanently relieved by removal of the appendix. Such cases should, therefore, be given careful consideration before operative measures are instituted."

Loser and Melchior reported permanent cure in 95 per cent. of cases of true chronic appendicitis, while in cases without typical attacks only 60 per cent. were cured.

The diagnosis, then, is of the greatest importance.

The main points in diagnosis are :—First, pain in the lower right quadrant of the abdomen. Aside from typical acute attacks with free intervals, pain is an unreliable symptom and fails to differentiate true chronic appendicitis from spastic constipation, colitis, enteroptosis, stone in the ureter, ovaritis, and even neurasthenia.

Tenderness is but little more reliable than pain. Keith has shown by dissection of fifty subjects that McBurney's point lies over the ileocæcal valve far more often than it does over the base of the appendix. Treves, in testing 27 healthy medical students, found tenderness over McBurney's point in 24 of them. (Friedman[3].) Inflating the colon with air will differentiate some conditions, but fails to differentiate colitis, enteroptosis, or chronic constipation, three of the most common sources of error. Temperature and leucocytosis, when present, are of the greatest importance, but in many cases diagnosed as chronic appendicitis neither is present. How often are those two most important signs of exacerbation omitted or overlooked!

Within the past two years a new method of examination has been introduced that is far more reliable than any of the methods above outlined. This is the examination with the X-ray, particularly palpation of the barium-filled intestine under the fluoroscopic screen. By this method it is possible to determine absolutely when the point of tenderness and pain are over the base of the appendix, over the ileocæcal valve, or over the cæcum, some distance from the appendix. It is possible to determine whether the cæcum is freely

1 Morris, Robert T., N.Y.M.J., 1916, CIII, 971.
2 Connell, F. G., J.A.M.A., 1916, LXVII, 335.
3 Friedman (J. C.), *Ill. Med. Jour.*, 1916, XXX, 100.

movable or bound down by adhesions. Visceroptosis, enteroptosis, spastic colon, and ileal stasis can also be distinctly seen. By careful methods the appendix can be outlined in eight cases out of ten. It is possible to determine accurately its size, shape, and position, the presence or absence of kinks and constrictions, and whether or not it is freely movable or adherent to other viscera.

The preliminary examination of the gastro-intestinal tract has, in my hands at least, had such important bearing upon the subsequent operation, I feel justified in taking the position that all operations on cases supposed to be chronic appendicitis should be preceded by a thorough Roentgen examination. My contention can best be emphasized by several illustrative cases.

The first case, an unmarried woman, 28 years of age, gives the following history :—

For six months she has had intermittent stabbing pains in the lower right quadrant of the abdomen, together with almost continuous soreness. The pain extends upward to the costal border and the tenderness as far medialward as the midline. The pain does not radiate to the groin nor to the right shoulder blade, but she has a continuous ache on the right side in the lumbar region. She has had no gastric or urinary symptoms, her bowels are regular, and she has never had jaundice. Her menstruation has always been irregular, accompanied by considerable pain in the pelvis, but the pain in the right iliac fossa is independent of this.

On physical examination heart and lungs were found normal, the abdomen level and tympanitic throughout ; on sharp percussion tenderness was found in the right iliac fossa extending upward to the costal arch and as far medialward as the midline.

There was no costo-vertebral tenderness. On palpation no definite muscle rigidity was found, but the cæcum was filled, could be rolled under the finger, and was tender. The kidney was not felt. The urine was normal, leucocyte count 12,600; X-ray picture of kidney negative for stones. On X-ray examination of the gastro-intestinal tract the stomach was found to be normal in size and shape, the greater curvature two fingers breadth below the iliac crest and the duodenal cap normal in contour. Emptying time of the stomach was four hours. At the end of six hours the head of the barium column was half way across the transverse colon, and the cæcum was freely movable, the appendix well filled and clearly seen. It formed a loop downward, with the distal end in the pelvis, dilated but not fixed. A kink was found in the proximal third. The proximal third of the appendix could not be easily moved, and over this point there was marked tenderness. At the end of three days the appendix was still filled.

A diagnosis of chronic appendicitis was made.

On operation the conditions found on Roentgen examination were fully confirmed. The appendix was removed, the patient made an uneventful recovery from the operation, and at the end of four months has gained thirty pounds and is completely relieved.

In a second case, a married woman, 28 years of age, the chief complaint was stomach trouble. The stomach trouble consisted of intermittent attacks of burning sensation, fullness, distension, belching of gas, and rarely heartburn. The distress was not influenced by the character of her food, was present whether the stomach was full or empty, and came on immediately after eating. In addition to this, during the past three years she has had several attacks of pain in the lower right quadrant, each attack lasting several days, and so severe she had to go to bed.

Physical examination was negative except for tenderness in the epigastrium and in the right iliac fossa. There was no muscle rigidity. The leucocyte count was 9,500, urine normal, gastric analysis negative. Four stools were examined, and all were negative for occult blood.

On X-ray examination the stomach was found to be normal in size, shape, position and outline. There was a spasm of the pylorus, which soon disappeared, followed by normal peristalsis. The duodenal cap was of normal appearance, the stomach emptied in four hours, and after six hours the cæcum was well filled. Repeated attempts to outline the appendix were all unsuccessful, but the patient complained of pain and tenderness exactly over the head of the cæcum. From these findings we concluded the appendix was occluded, and a diagnosis of chronic appendicitis and gastric neurosis was made.

On operation the appendix was found in the usual position, fixed by adhesions, much thickened, reddened at the tip, and pus was found in the distal end.

In a third case the patient complained of pain in the epigastrium at the right costal border. He had had this pain intermittently for three years. It was accompanied by gastric distress immediately after eating, not influenced by the character of his food, and he said he felt better when his stomach was empty. The pain and distress have never kept him awake at night, he has never had jaundice, black or grey stools, no nausea or vomiting.

Physical examination was negative except for rather general epigastric tenderness. His urine was negative, four stools were all negative for occult blood, gastric analysis was negative, and his leucocyte count was 10,000.

From the history and physical examination a diagnosis of chronic cholecystitis was made, but because of the possibility of gastric or duodenal affair, it was decided to make an X-ray examination of the gastro-intestinal tract. The stomach was found to be normal in size, shape and position, good tone, no filling defects, and normal peristalsis. The duodenal cap was normal in contour and movable. The point of tenderness was entirely outside of the stomach about one inch below and medial to the duodenal cap. The emptying time of the stomach was four hours. After twelve hours the cæcum was well filled. It was drawn toward the midline and absolutely fixed. The appendix was only partly filled, but was fixed and pointed upward.

On the X-ray findings the diagnosis was changed to chronic appendicitis.

When the abdomen was opened the gall bladder was found to be perfectly normal, the cæcum was drawn over to the midline and adherent to the anterior

abdominal wall. The appendix was very much thickened, with several constrictions, and pointed directly upwards. The tip was in contact with the greater curvature of the stomach. It was bound by adhesions to the anterior abdominal wall and loops of small intestine. These were divided, the cæcum freed, and it dropped back to its normal position.

The patient made an uneventful recovery, and has been entirely relieved of his trouble.

I could cite many other cases, but these few instances, I believe, will demonstrate the value of this new method of examination, and I feel warranted in stating that in the X-ray we have a most important addition to the usual methods of diagnosis in chronic appendicitis, and that with its use practically every true case of chronic appendicitis can be determined before operation. Thus much unnecessary surgery can be avoided and the percentage of successful operations increased from 60 per cent. to 95 per cent. The good repute of surgery demands that wherever possible a preliminary X-ray examination be made, and where this is impossible the uncertainty of the diagnosis, and hence the result of treatment based on such diagnosis, should be frankly stated to the patient and let him assume the responsibility.

THE AFTER TECHNIQUE OF THE OPAQUE MEAL.

By R. Knox, M.D.

This is an attempt to briefly systematize the ordinary technique of the opaque meal in order that the advantages to be derived from it may be summarized, the records be readily referred to, and the physician or surgeon may have at hand a complete record of the examination.

The method described is not in any sense a new one, but merely an adaptation of other methods, with a few new ideas incorporated here and there to render it complete. It has been found so useful at the Cancer Hospital, Fulham Road, and at King's College Hospital, that I venture to describe it in the hope that others may at least find some points in it which are worthy of adoption.

In these days of stress and rapid rush from place to place method or system is most useful, particularly where, as so often happens, the detail work has to be left to others. By utilizing the work of others as much as possible it is easy to get over a great deal of work, and if the method is complete the results may be of great value.

The technique of the opaque meal is too well known to require elaborate description, though an attempt to standardize technique would be useful. The ordinary examination consists of :—(1) Screen examination ; (2) Radiographic examination ; (3) Both combined. Either method used alone gives

but imperfect data upon which to base a diagnosis—when combined the two furnish the ideal system. The record of the examination is drawn up from a scrutiny of the plates together with the screen pictures. The latter are only of individual interest, unless a method is employed for at once obtaining a record of what is seen.

This may readily be done by tracing the outline of the barium-filled organs upon the lead glass screen in front of the fluorescent screen. These tracings when completed form the visible record of the examination, but it is still necessary to convey the findings to the physician or surgeon who has charge of the patient. The most satisfactory manner in which this can be done is for the surgeon to see the plates with the radiologist, when points can be discussed with benefit to both, and a diagnosis arrived at. In large hospitals

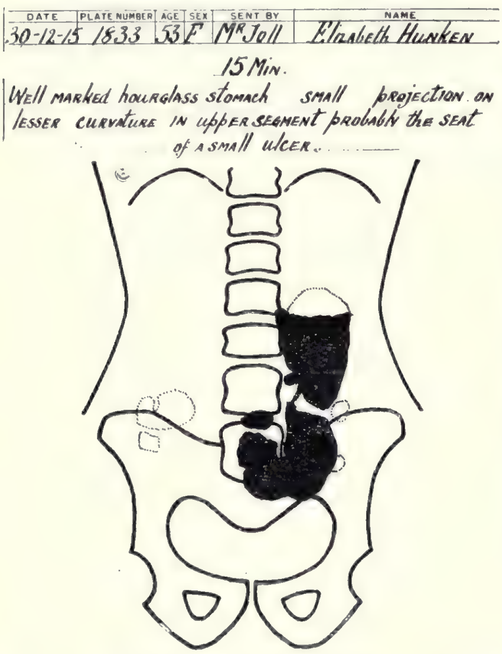


Fig. 1.—Showing diagram drawn in by means of the pantograph, particulars of case and description of the conditions found.

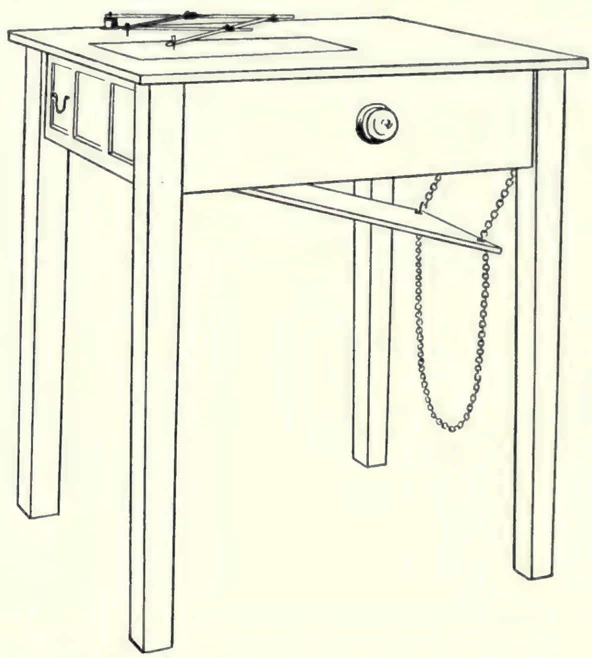


Fig. 2.—Showing general construction of table.

and in busy practice this is not always a practicable scheme, and some other method must be found by which to convey the results in an intelligible way to the physician or surgeon.

The following procedure is an elaboration of what might be referred to as the after technique of the barium meal examination, in so far as it supplies a practical method which as far as possible reduces everything to a standard.

The method consists in taking tracings or reduced outline drawings from the tracings already obtained, and from the plates which have been exposed and developed; when the latter are dry the record may be prepared.

A pantograph is employed to reduce the tracings to a convenient size; the working of this instrument is extremely simple and accurate. An outline

drawing is provided on sheets of paper ; this has been prepared from a study of a number of radiographs, and may be regarded as the standard chart. (Fig. 1.)

The number of tracings will vary in individual cases, but as a rule six form a convenient number for most purposes. These are photographed together on one whole plate.

A special table has been designed to facilitate the tracings of the negatives. Figs. 2, 3, and 4 illustrate the general plan of the table ; the table top is drawn to scale, as is also the elevation plan (3 inches to the foot), and all the necessary dimensions are figured, so that anyone can construct it from the

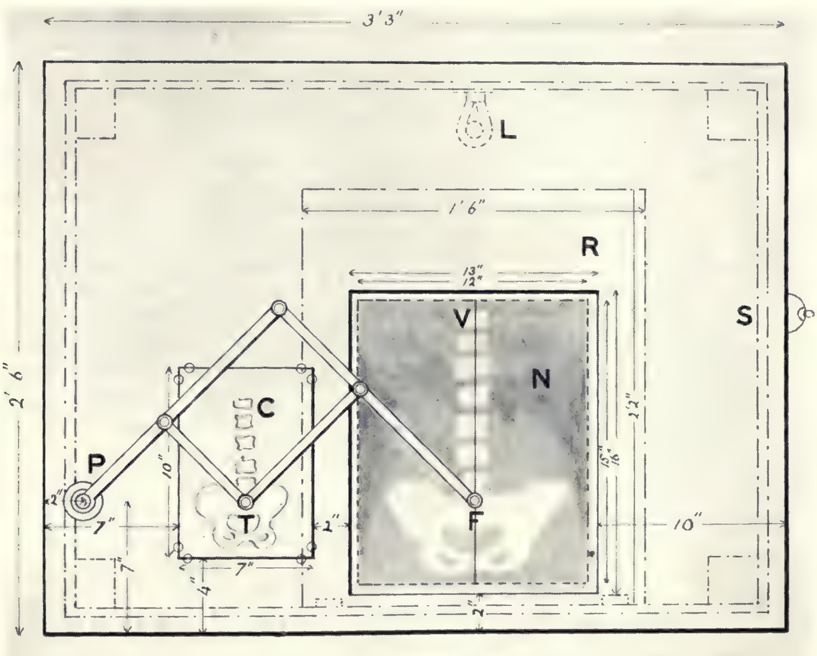


Fig. 3.—Showing pantograph in position, negative in illuminated window and diagram in position for tracing.

plan. On the right hand side of the table top a large hole is cut ; into this a piece of thin plate glass is accurately fitted, its surface being flush with the table top. The negative to be traced is placed film down upon the plate glass, so that the spine corresponds with the vertical thread V, which is stretched below the glass. Beneath the table is a board R, covered with white paper. The reflected light is obtained from a lamp (L), controlled by the switch S. The reflector is hinged to the table rail, and the angle adjusted by a string or fine metal chain. A card, similar to Fig. 1, on which the tracing is made, is slipped under the heads of drawing pins at the corners. Once the relative position of negative and card have been found the drawing pins need not be removed, they form fixed points for controlling the position of all the cards

used. A pantograph works from the fixed point P. This consists of a brass pin let into a brass plate, and forms a convenient point from which the pantograph may be worked.

The plate is "flush" with the table top. The pin can, therefore, be withdrawn at any time, leaving the table top clear for other work.

The outline of the opaque food in the stomach and intestines seen on the negative is carefully followed with the tracer F, the reduced copy is traced on the card by the pencil T. The degree of reduction may vary, but a convenient size is about $2\frac{1}{2}$ to 1. The card used is 10 inches by 7 inches in size, and has a space at the top for details of the examination, hospital records, and any other particulars required.

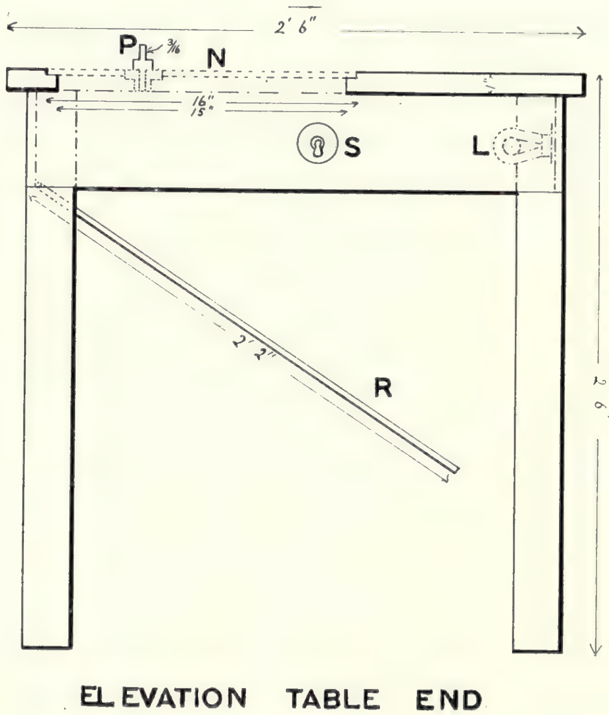


Fig. 4.

Each negative is traced in the same way.

When all the tracings are completed, the outlined parts are filled in with drawing ink. Variations in density may be shown by varying the depth of the colour. A complete set of drawings has now been prepared—all data of exposure times, positions of food, etc., may be printed on the cards with the particulars relating to the patient. Much time and labour can be saved by having a set of rubber stamps prepared with the names of parts (see Fig. 6). Each diagram can then be quickly lettered as indicated.

The complete set is now fixed upon a convenient white board, fitted with slots for the accommodation of the drawings, and the set is then photographed

upon a whole plate and developed. The plate when dried is ready for printing. (Fig. 5.)

The finished print furnishes a complete record of the examination on a

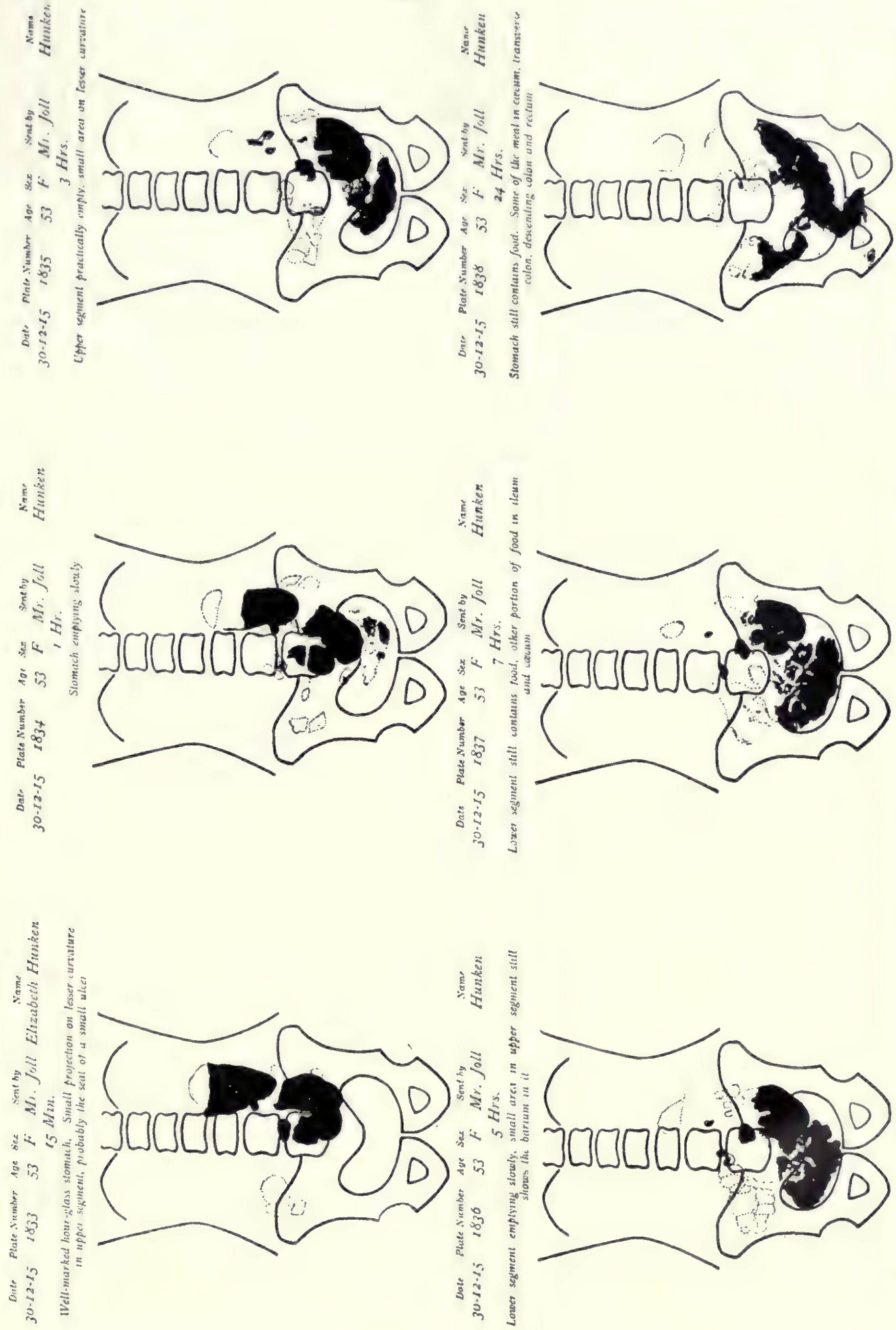


Fig. 5.—Illustration from a print taken from the negative of the set of tracings, all data has been filled in. The times given indicate when the plate was taken. In this set each card has had inscribed upon it full details, in practice it is only necessary to do this on the first card, the others need only have the name and a distinguishing number.

convenient size of paper, and this may be sent to the wards or to the physician or surgeon, and furnishes him with a convenient reference which may be incorporated in the notes of the case.

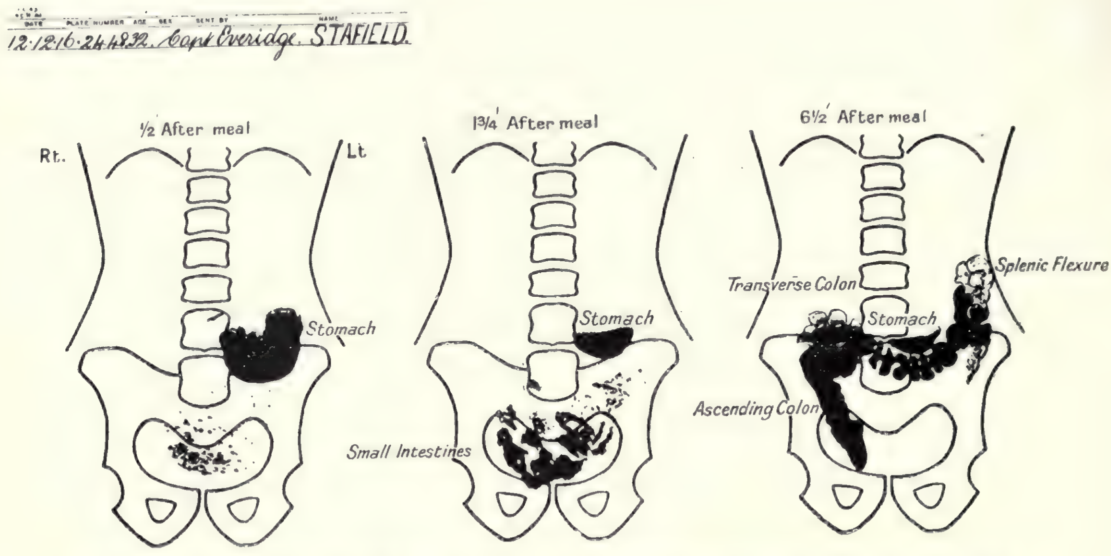


Fig. 6.—To show the marking of the parts; this is arranged for by having a complete set of rubber stamps prepared.

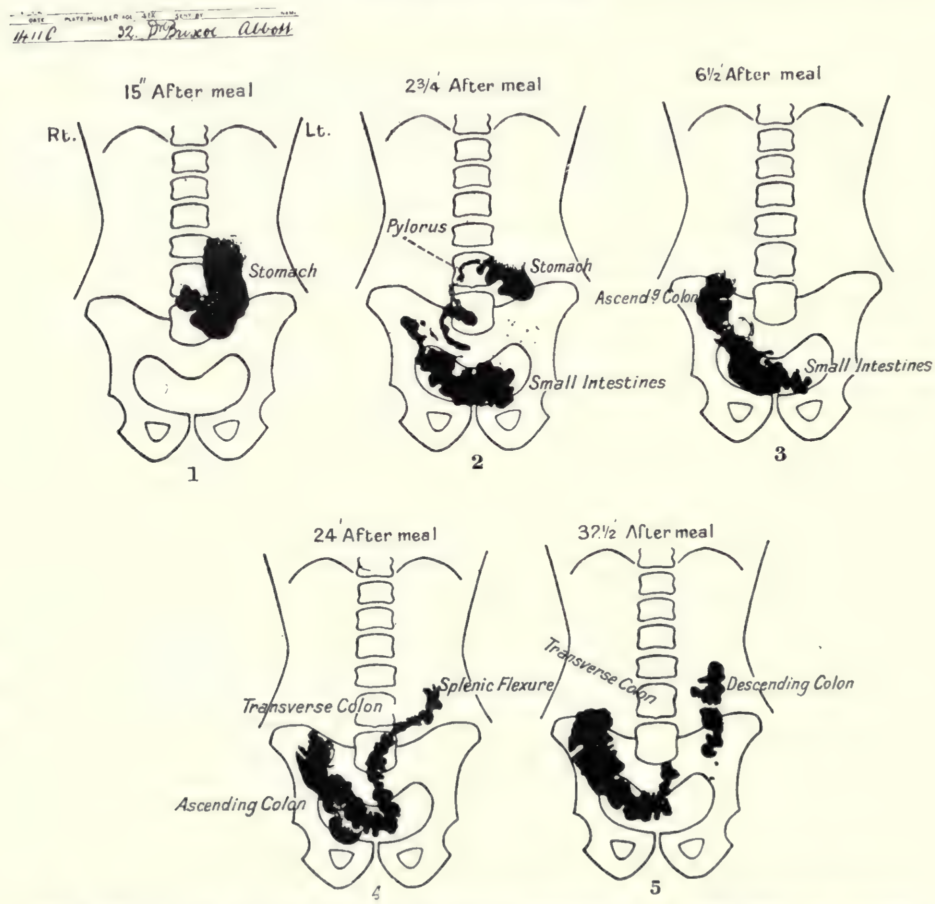


Fig. 7.—Record of a case which was sent for examination; the radiographic report is given along with the condition found at the operation. This case illustrates the manner in which the method may be of use to the radiologist—the complete record of the case can be filed with the negative and cards. Then it is ready for handy reference at any time.

REPORT OF X-RAY EXAMINATION, NOVEMBER 14TH, 1916.

Meal finished, 8.50 *a.m.*

PLATE I.—Fifteen minutes after. Stomach moderate in size and fairly active.

PLATE II.—Two and three-quarter hours after. Stomach emptying rapidly, considerable irregularity at pylorus.

PLATE III.—Six and a-half hours after. Stomach empty. Food in cæcum and ascending colon to hepatic flexure.

PLATE IV.—Twenty-fours hours after. Food in colon as far as splenic flexure. Distinct displacement of transverse colon. Hepatic half lies parallel with ascending colon.

PLATE V.—Thirty-two and a-half hours after. Condition is much the same as in last plate, except that there is now some opaque food which has passed into descending colon.

*PLATE VI.—Forty-eight hours after. Transverse colon is still well filled and situated very low in pelvis.

*PLATE VII.—Fifty-four hours after. Marked delay in transverse colon, operation, November 27th, 1916. Operation lasted 1½ hours. Appendicectomy and peritoneal plasty.

*These plates are not shown in the record of the examination, Fig. 7.

REPORT OF CONDITION FOUND AT OPERATION.

Incision just to right of linea alba through ant. sheath of rectus, rectus was then retracted entire and front sheath and peritoneum were divided. Incision was about 6 ins. long and extended from the umbilicus downwards. Transverse colon was found in the pelvis bound down by adhesions to the cæcum, which was kinked in one or two places. The appendix and cæcum were also adherent to the sides of the pelvis. The adhesions were divided by scissors and the appendix was removed. Appendix is short and stumpy and somewhat fibrosed. The adhesions uniting transverse colon and cæcum were then dealt with. They were divided transversely and stitched longitudinally so as to secure a complete peritoneal covering for the intestine. The transverse colon was then made to extend from about the right iliae brim transversely across the abdomen towards the splenic flexure. The incision was then closed in the usual way.

The method described is subject to considerable modification. When it is necessary to save time the tracings may be drawn upon reduced charts on a case sheet and the photographic process omitted. The drawings may be reduced to a convenient size by the pantograph, and the complete set is ready for the consideration of the surgeon. This could quite readily become a routine method and would be found useful in general hospital or military work.

In the photographic method of reduction the intermediate stage of photographing upon a plate may be left out, the reductions can be made upon a bromide paper. This saves a considerable amount of time. The whole process need not take more than an hour or two if the paper is quickly fixed, washed and dried.

It may happen that the radiographer may wish to send out prints from the plates—these, when of full size, are too bulky for convenient use ; in order to reduce the inconvenience to a minimum I have had prepared for me a large viewing box which will accommodate six plates, 15 by 12-in. size. Convenient blinds are provided for screening purposes ; the six plates can be reduced at one exposure to a whole or a half-plate size. When a print is made from this plate the complete record is now ready for the surgeon, and may take the place of the tracings described above or may accompany them

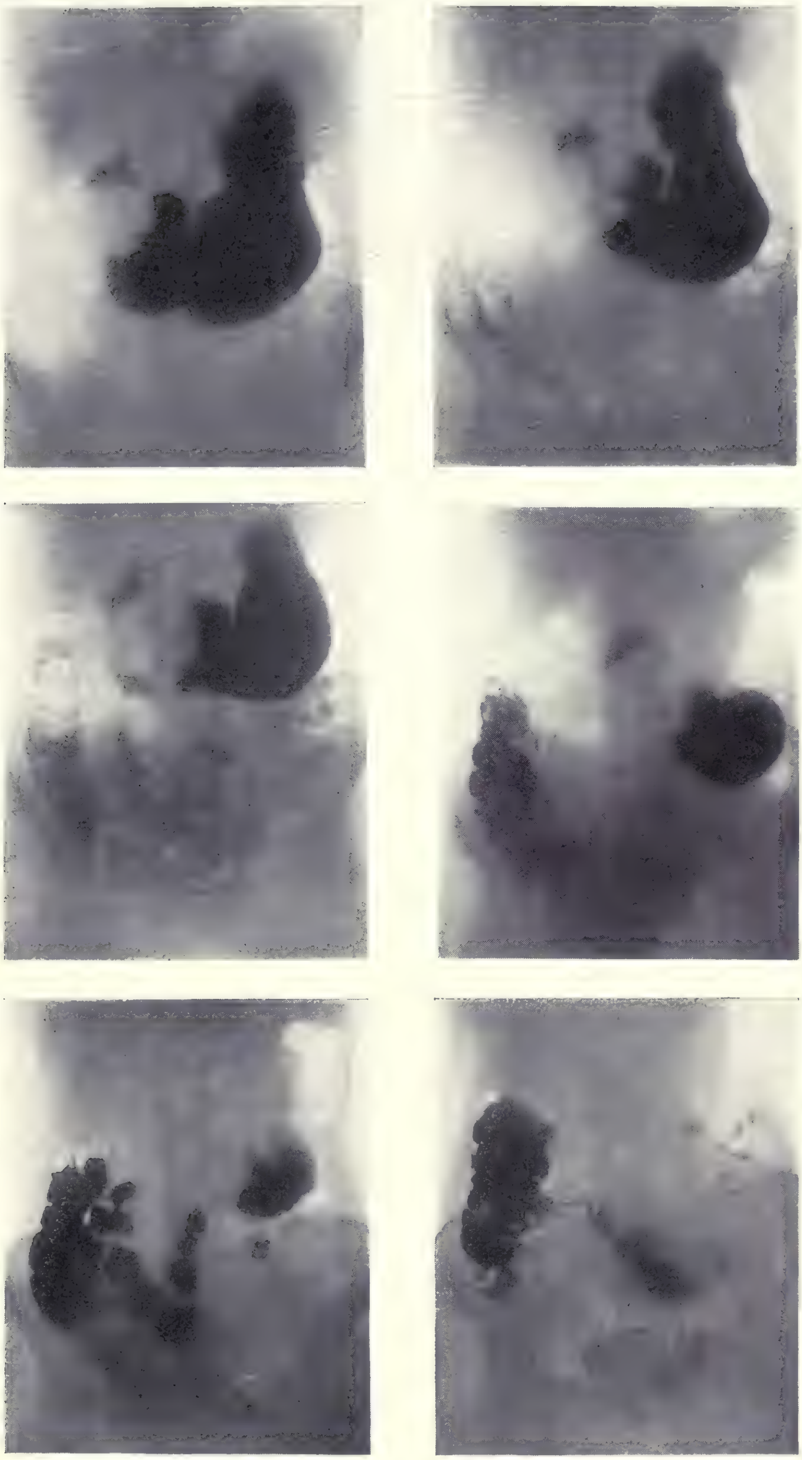
when both are required. The surgeon is now completely independent of the original plates—these are, therefore, stored away and may not be required again, except when questions of detail may arise. The set of tracings, negative and print, are also stored in an envelope, indexed, and placed in the filing cabinet.

The chief object of this technique is to provide a convenient record of radiographic work for the use of the physician or surgeon. The record will also be a great convenience to the radiologist, for when he comes to compare a large number of cases the prints obtained of the complete examination are most convenient; he can carry a hundred or two of these records, and when comparing the sets they are much more conveniently handled than the original plates.

A further advantage will be found when it is desired to prepare cases for publication.

In order to further illustrate the advantages of a technique of this kind, a number of reductions from 15 by 12 plates are shown. The reduced prints are undoubtedly the more complete so far as the record is concerned, but it is not always possible to get a uniform set of negatives from which to obtain the reduction, a negative which will give a very poor reduced print may be quite good enough to give a good tracing, so in some cases it may be well to use both methods. A number of tracings of the screen examination may be available when no negative has been taken; these tracings may be placed upon the table and reduced by using the pantograph. By using the combined method the record of the case may be rendered more instructive and complete than when either is used alone. The table may be used for other purposes than that of the opaque meal. Negatives of other subjects may be readily reduced.

I have been greatly helped in the development of the technique by Mr. St. George Caulfeild, who is responsible for the production of the table, and the excellent scale drawing which illustrates it, and to Mr. Holland for designing the large viewing box used for the photographing of the large plates, and also for perfecting the photographic technique of the method.



¼ hour — 1 hour

3 hours — 5 hours

7 hours — 24 hours

Reduced prints to illustrate article on "After Technique of the Opaque Meal."
Marked deformity at pyloric end of stomach. (Carcinoma.)

Plates taken ¼, 1, 3, 5, 7, 24 hours after ingestion of meal.

PLATE 29.

¼ hour

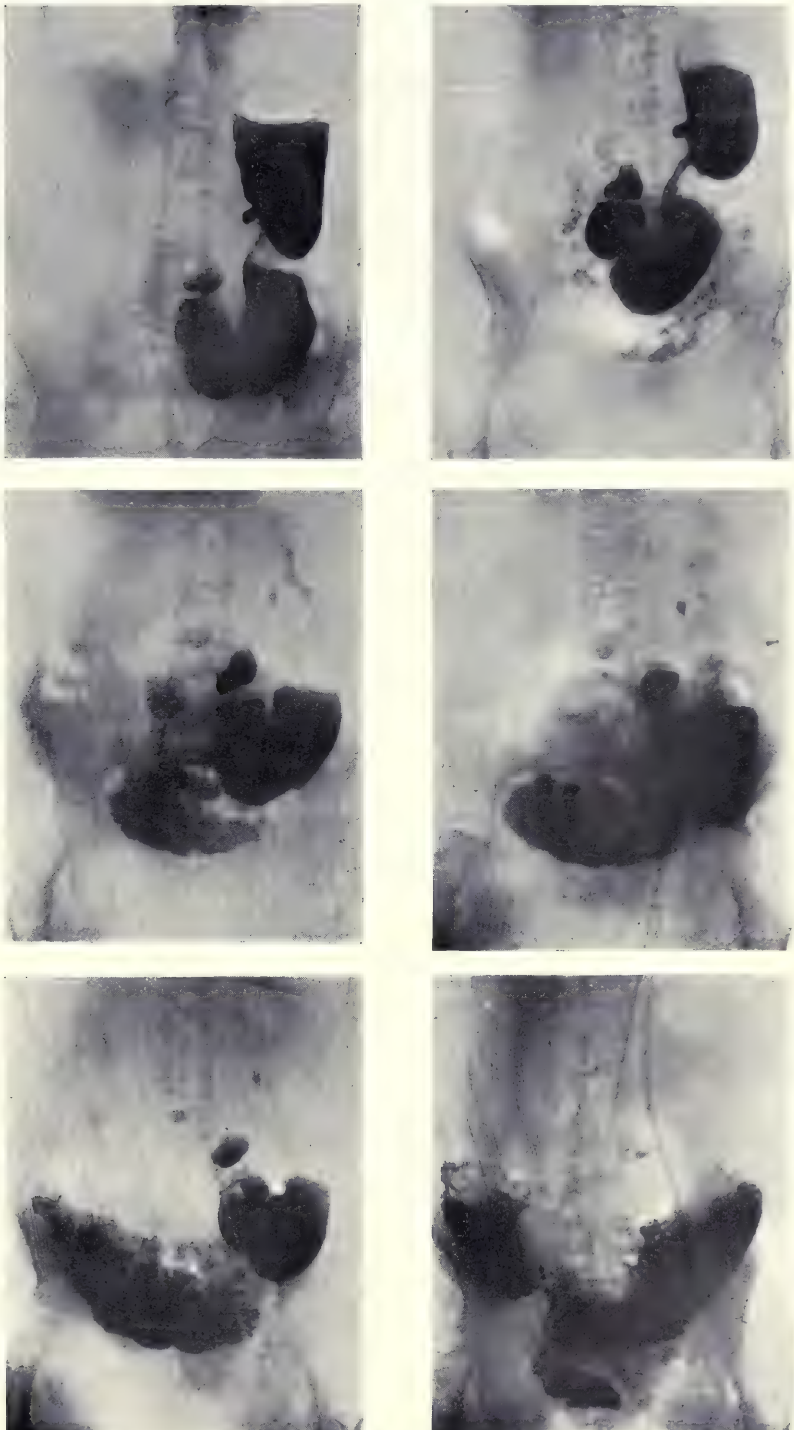
1 hour

2 hours

4 hours

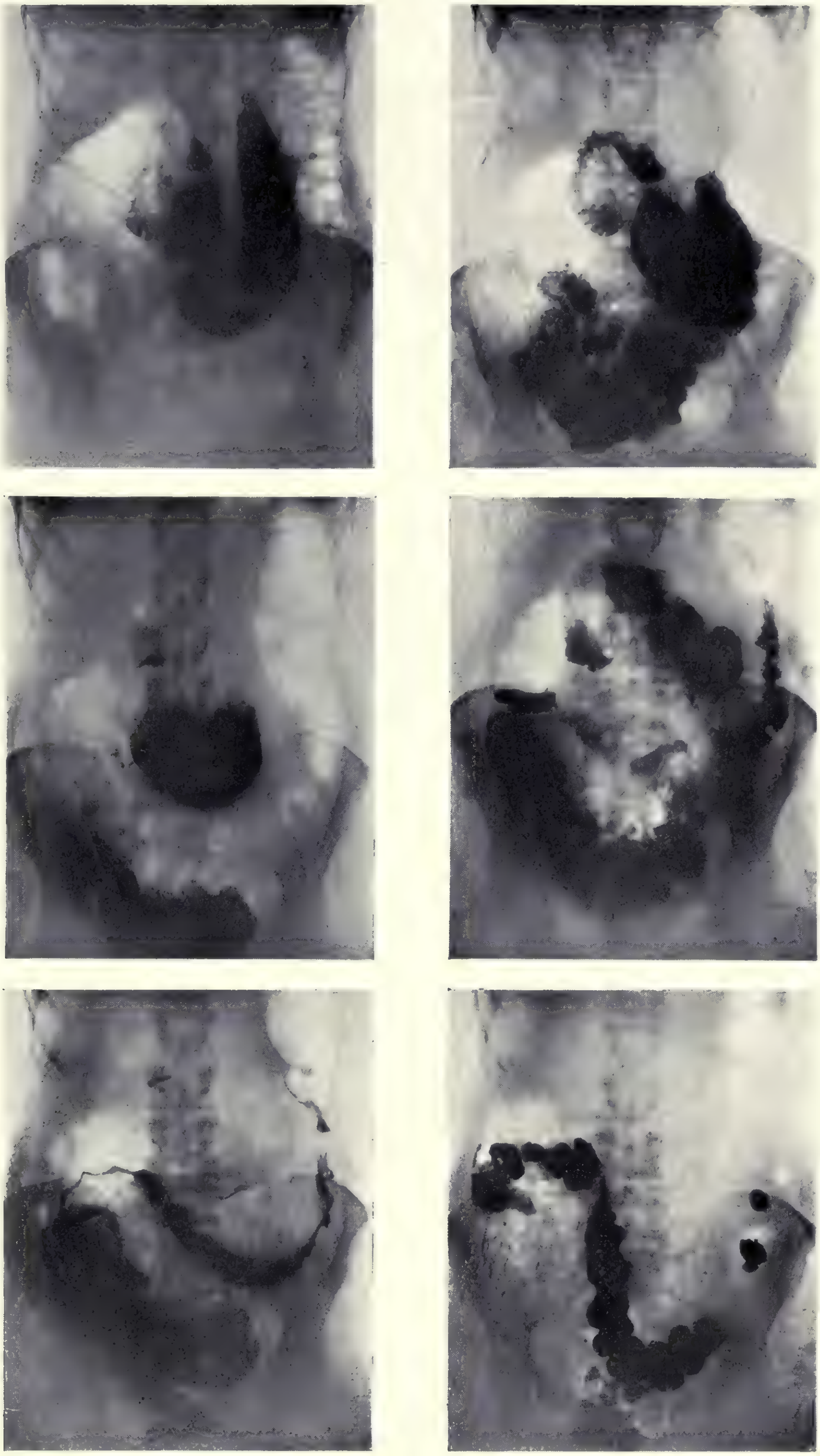
7 hours

24 hours



Hour-glass contraction of the stomach.
Plates taken ¼, 1, 2, 4, 7, 24 hours after the meal.

PLATE 30.



¼ hour

1 hour

3 hours

5 hours

7 hours

24 hours

Reduced prints to illustrate article on "After Technique of the Opaque Meal.
Plates taken ¼, 1, 3, 5, 7, 24 hours after ingestion of the meal.

A RARE AND INTERESTING CASE.

By Herschel Harris.

The patient had all the symptoms of a vesical calculus, and the radiogram made it appear as though there were three calculi present. The operation revealed that there was one calculus present, the other two shadows being calcified hydatid cysts.

On further examination a floating hydatid cyst was found in the abdominal cavity.

The case was under the charge of Sir Alexander MacCormick. His theory is that a daughter cyst escaped from the mother cyst and fell down into the recto-vesical pouch and then grew and burrowed through into the bladder and ruptured and then became encrusted with phosphates.

Referring to the print:—

(1) Indicates a calculus.

(2 and 3) Indicate a calcareous hydatid cyst.

1.—Vesical Calculus.
2 and 3.-Calcified Hydatid Cysts.
Radiogram by Herschel Harris.

(*We are indebted to Dr. Jordan for the print and the notes of the above interesting condition.*—Ed.)

REPORT OF SOCIETY.

TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

Held in New York City, September 12th, 13th, and 14th, 1916.

The President, Dr. JEFFERSON D. GIBSON, Denver, in the Chair.

President's Address.—Some Speculations for the Future.—Dr. Gibson stated that by the plan of treatment which he advocated the death rate from tuberculosis could be made probably less in eight years in the United States than the present death rate from small pox. He outlined his plan as follows:—Make use of the health boards of every city and county. Every child in the public or other school should be examined for tuberculosis, and treated, if needed, under the direction of the board of health. The health board or commissioners should set aside and maintain a department for this special school work, known as the Tubercular Department, and the chief or manager of this department, with all assistants needed, should devote their entire time to the care, examination, and treatment of the school children. Every child that is tubercular, or shows a reaction, or any sign of tuberculosis, should be treated, in addition to the ordinary hygienic and dietic measures, by the X-ray for its direct effect on the bacilli and the lung tissue; by static electricity, for its direct effect upon the heart, nervous condition and general metabolism; and by inhalations of an ozonized oil nebula for its effect on the cough. By this method during the past year he had been able to save from death 92 per cent. of all applicants, of all stages and complications, of pulmonary and other forms of tuberculosis. Tuberculosis in young children was usually glandular, and most latent or incipient tuberculosis in children was in the bronchial, mediastinal, cervical, abdominal or inguinal glands. It was in this stage that the disease should be detected, because it was well known that the X rays would cure a tubercular gland.

The Treatment of Hypertension and Complicating Conditions.—Dr. William Benham Snow, New York, said he viewed hypertension as secondary only to a toxic cause, and as the actual cause of the resulting arteriosclerosis. The heart compensated, and if the tension was relieved the labour of the heart would be relieved and the arterial degeneration to a degree arrested. In the treatment the most important factor was the regulation of the diet. In advanced cases all animal proteids should be eliminated from the diet, and in all cases they should be reduced in amount. In addition to the regulation of the diet, the high frequency current should be employed, by the auto-condensation method. The patient was given daily treatments until the pressure fell to normal or recurred to the same figure following each daily treatment. This would be the compensation point for the individual case. At that point a fixed tension would persist despite the treatment, and beyond that it would be impossible to lower the pressure. After finding that point the treatments were given just often enough to maintain the pressure approximately at that lowered point.

Contact in Electrotherapeutic Applications.—Dr. Fred H. Morse, Boston, said this was an important factor in electrotherapeutics. He considered the shapes and sizes of electrodes, the best materials to be used, etc. He described an electrode which had proved very successful in his hands, made of asbestos combined with flexible copper gauze, covered with linen and with a rubber backing.

Roentgenographic Diagnosis of Dental Infections in Systemic Diseases.—Dr. Sinclair Tousey, New York, read this paper, and showed numerous lantern slides. He drew the following conclusions: A putrescent mass in the pulp chamber of a tooth may exist for months, or years, because the walls of the cavity cannot collapse and are incapable of throwing out granulations and eventually filling the cavity with healthy tissue, like the natural process of curing an abscess in the soft tissues of the body. This putrescent mass may constantly poison the bony tissue surrounding the apical foramen sufficient to produce an effect clearly recognizable in a radiogram. This condition may be unknown

to the patient, and sometimes not reveal itself to the usual tests applied by the dentist. From this long-existing source of infection secondary lesions and symptoms of the gravest and most diversified character may arise. The X-ray is to be depended upon to show whether or not the source of trouble is connected with the teeth or the pneumatic sinuses, and if so, whether the trouble is due to malposition and unnatural pressure or to infection. It would be a mistake to regard every case as due to the teeth and pro-acquit them of any complicity in the matter.

The Treatment of Inoperable Carcinoma by Bipolar Ionization.—Dr. G. Betton Massey, Philadelphia, said that in this method the active needles were inserted just beyond the periphery of the growth, while the inactive, negative electrode was inserted in its centre. As no material amount of current traversed the general body structures, the method could be pushed to the point of producing a boiling temperature in the larger growths, thus adding the valuable agency of heat to the devitalizing chemical action of the dispersed ions of zinc from the erosion of the zinc electrodes attached to the positive pole. This method was applicable to large growths when heavy currents were needed. In small growths the ionization alone was sufficient, applied in the unipolar method. Illustrative cases were reported.

Prompt Removal of Exudate from Trauma.—Dr. A. B. Hirsh, Philadelphia, drew the following conclusions: Prevailing modes of removing exudate from the tissues after injury are altogether inefficient, therefore inadequate, and lead to needless invalidism through non-union or deformity after fracture or other interference with function. Prompt removal of any excess of effused blood and lymph is necessary for union of broken bone or lacerated soft structures, leading to resumption of normal function. Mechanical modalities, largely electrical, alone can supply the deep molecular contraction of tissue required to force back into torn vessels their misplaced fluids, and where such extravasated material has had time to become organized to sufficiently soften it to bring about its absorption.

Contraindications to the Use of High Frequency Currents.—Dr. Frederic de Kraft, New York, gave as the contraindications to the use of the high frequency current all conditions where a tendency to hæmorrhage existed, for instance, in cases of pulmonary tuberculosis with a history of recent hæmorrhage; or the pelvic organs, uterus and ovaries, if bleeding had occurred recently. As it stimulated cell functions it was contraindicated in hyperthyroidism, Hodgkins' disease, leukemia, etc. It should not be used in cases of walled-in pus, tubercular glands, or acute rheumatism. It was seldom wise to employ it during menstruation. In certain cases of obesity it increased the weight.

The Importance of Dieting in Medicine.—Dr. Anthony Bassler, New York, in this paper outlined the facts to be kept in mind in diets for diabetes, cardiac decompensations, nephritis, polyarthritis, gall bladder disease, intestinal toxemias, and constipation.

The Condenser Discharge; Its Use in Diagnostics and Treatment.—Dr. Frank B. Granger, Boston, said that in this method of testing muscles a condenser of known capacity was charged from the main or from a battery to a constant voltage, and was then discharged through a muscle. For muscle testing this method bade fair to supplant other methods, as we had an exact numerical equation, instead of vague terms, and thus the improvement of the patient could be determined readily and rapidly. In therapeutics more work must be done, more cases tabulated and compared, before we could assign it its place in therapeutics.

Uterine Fibroids.—Dr. Mary Arnold Snow, New York, after going into the frequency, cause, classification, diagnosis, structure, growth, site, and symptoms of uterine fibroids, advocated their treatment by the X-ray, preferably the fractional dose method. The advantages of the X-ray treatment were: It left the reproductive system intact, though sterile, whereas the radical operation meant incalculable reflex shock to the system mentally and physically. The X-ray treatment was an ambulatory treatment. There was no danger from hæmorrhage. The patient enjoyed her usual comfort. With proper precautions there should be no disturbance of the digestive system, as from the after effects of an anæsthetic, and there should be freedom from danger to life. The lowest mortality from surgery

was three to five per cent. There was no period of convalescence, and insanity never occurred. The symptoms of the induced menopause were less pronounced than those following an operation. The contraindications were: Such severe symptoms that the life of the patient would be endangered by waiting for results from the X-ray; pedunculated submucous fibroids; infectious gangrene or malignancy, or where the fibroid was associated with disease of the adnexa.

The Value of the Cooper Hewitt Quartz Lamp in the Treatment of Alopœcia.—Dr. William H. Dieffenbach, New York, in this paper gave a verification of the claims of Dr. Franz Nagelschmidt, of Berlin, in the treatment of alopæcia by means of the ultra violet rays emitted from the quartz lamp. He showed lantern slides of numerous cases in his own experience and that of Nagelschmidt.

Subacromial Bursitis.—Dr. J. E. Deering, Worcester, Mass., said the treatment of subacromial bursitis in the first stage consisted in the use of a rather long treatment with a high candle power lamp, followed by twenty minutes to a half an hour of diathermy. Often four or five treatments would relieve and cure a case. Where there was tension in the bursa static sparks should be used, preceded by the high candle power lamp. In the second stage, during the formation of adhesions, one should use the high candle power lamp, fifteen or twenty minutes of diathermy, and fifteen or twenty minutes of static wave if that be well borne. Where contraction of adhesions had taken place diathermy might be omitted from the foregoing treatment.

Some Phases of Intestinal Stasis and its Treatment by Physical Measures.—Dr. William Martin, Atlantic City, detailed the history of an interesting case of intestinal stasis treated and cured by a combination of diathermy, light treatment, and vibration of the intervertebral spaces, and the static wave and the slow sinusoidal currents.

The Treatment of Infantile Paralysis.—Dr. Frank E. Peckham, Providence, R. I., reported three cases of infantile paralysis treated in the early stage by the static wave current over the lumbar region of the spine, the 500 c.p. lamp over the affected muscles and over the lumbar spine, and later vibration and gymnastic exercises.

The Treatment of Infantile Paralysis Based on the Present Epidemic.—Dr. H. W. Freuenthal, New York, said from the present methods of treatment in the acute stage no apparent advantage existed in any line of treatment further than in the fact that, in cases where anterior poliomyelitis was detected immediately, the disease had been checked and paralysis averted by the use of immunizing serums obtained from persons who had already had the disease. Treatment should be begun in the second week. Pain could be relieved by warm bath or an electric light bath. The affected muscles should be treated with the sinusoidal current alternating with a combined galvanic and faradic current. Massage should be instituted the moment the acute inflammatory symptoms disappeared. Attention should also be given to a class of active and passive exercises before a mirror, having the patient concentrate his mind on the affected muscles.

REVIEWS.

The Journal de Radiologie et d'Electrologie, Vol. II., March-April, 1916) contains an article "On the Extraction of Foreign Bodies under Control of the Fluorescent Screen used Intermittently," by L. Ombredanne and R. Ledoux-Lebard. The writers describe the methods adopted by them in the Lycée Descartes Hospital in Tours, where the specialists are centred, and where the services of surgery and radiography are situated. It is a secondary hospital, not receiving patients direct from the Front. Further, all patients having foreign bodies were referred to them by other medical officers,

who either did not wish to extract them themselves, or who had failed after several trials. Even under these unfavourable circumstances on the 5th of November, 1915, a consecutive series of 110 foreign bodies, removed from 100 patients, were recorded, without one failure. On the 16th of February, 1916, a further series of 100 cases (with 109 foreign bodies), all of which were successfully removed, thus showing 100 per cent. of success in removing 219 foreign bodies from 200 patients. A group of foreign bodies situated in the same region, and reached by one incision, were counted as one foreign body. The actual total of separate pieces removed was 319.

Other statistics are quoted giving from 7 to 4 per cent. of failures, and their conclusion is that in the ordinary methods of localization there are 5 to 10 per cent. of failures.

TECHNIQUE.

Screening.—No new methods have been adopted, but thorough precautions have been taken to safeguard the operators from undue exposure to the ray. On a patient coming into the hospital he is either sent to the X-ray department or that department notified. Fluoroscopic examination is then made, the authors believing that the more cumbrous methods of localization, such as by the compass of Hirtz, which is probably one of the most exact of the innumerable instruments of this type, takes too long. The authors insist upon the value of screening, thus the anatomical, medical and surgical knowledge of the radiologist is required, first, to determine from the movement of certain muscles, for instance, the location of a foreign body in that muscle, his medical knowledge would lead him to recognize the existence of an inflammation, the presence of an abscess, the presence of adhesions, and many other ways to advise the operator in matters much more important and telling him the depth to within one millimetre. His surgical knowledge will enable him to point out the path of practical surgical access.

The X-ray Negative.—This is used to confirm the screen findings and to afford a closer study of the conditions either in the bones or in the adjacent tissues. The patient then has been screened, foreign bodies localized, and finally, plates taken. When, through the question of economy, either of plates or of time, a choice has to be made between screen localizing and plate localizing, the former is preferred. Following the decisions taken, those who are to be operated upon during the week are singled out.

Preparation of the Operating Room.—The operations in Tours are performed in the large X-ray room, where some Mondays as many as thirty people are accommodated comfortably. All the windows are properly curtained in black, there is abundant electric light under suitable control. Portable lights, on stands, with powerful reflectors, are available. Every precaution is taken that a burnt out fuse may be replaced instantly. Two tables are prepared, one the X-ray couch with a wooden top covered with aluminium, beneath which is the X-ray tube, movable in all directions. This is the operating table. Alongside of this is a strongly built wooden table, upon which the patient is anæsthetised. Where immobolizing cushions are needed these are filled with straw, instead of sand, so as to be transparent to the ray. The usual accessories for an operation are within reach. The patient, properly anæsthetised, is moved on to the X-ray table, properly disposed for operation, with a surgeon on one side and the radiographer on the other, having under his control the diaphragm, the coil, switch, and the light switch. The field of operation is then prepared as usual, suitably protected by sterile sheets, with a sterile sheet drawn over everything. While the operator and his assistant are preparing the instruments, the radiographer locates foreign body, centres it, and closes the diaphragm, leaving a field of about 1½ inches with the foreign body in the middle. He is then handed a sterile pointer, Lebard using an instrument like a perineal needle, centreing this on the image of the foreign body as shown on the screen. The current of the tube is then cut off, the covering sheet lifted, leaving the needle touching the skin. Very often the point so marked is one or two millimetres, sometimes it is two or even three centimetres out from the point marked when locating, due to change of position, etc. The operator then asks for the depth and cuts down on the point marked by the needle. The cutting is then continued to

the depth indicated, or a bone structure is met. At times the foreign body is found at the first attempt. If at the depth given, the foreign body be not found, or a bone structure is encountered which must be attacked with precision, operator stops, ligatures all clamped vessels, removing the forceps, which would interfere with the field of view, and says to the radiographer, "Just a glance, please." The surgeon and his assistant step back, sterile sheet is thrown over the patient, which is lifted at the two corners next the surgeon, who is thus able to see underneath, and the radiographer, with his screen on the other side works from above this sheet. Having located the foreign body, he says, "I see it." The operator then using a long sharp pointed director moves it until its shadow coincides on the screen with that of the foreign body, the radiographer directing him to move it forward or backward, to the left or to the right until exact; when it exactly coincides, he says, "You have it." The current is again stopped, the sheet removed, the director having been kept in position by the operator when a second attempt is made to find the body Very often the foreign body is found on this second attempt. Occasionally it may be necessary to have as many as five or six of these glances at the screen in difficult cases, especially where some organ intervenes in the path leading to the foreign body. When a foreign body has been removed, final examination confirms that there is nothing left behind. With this technique (apart from the complications arising from some unsurmountable physiological difficulty such as an anatomical anomaly or some serious anæsthetic difficulty) one cannot but succeed, as the operator may be guided step by step, no matter what the position, the nature, or the size of the foreign body. The confidence thus given the operator is far from negligible.

One has only to be careful to follow the ray perpendicular to the table along the path of which the foreign body is to be found, and which the radiographer has already marked at the commencement of the operation. The operator knows that no matter how often he loses his way he can be instantly guided by the radiographer.

Foreign bodies imbedded in bone furnish one of the best examples of the utilities of the method. Placing the shadow of the foreign body in the centre of the trephine ring one has only got to work it down to be absolutely sure of reaching the body. The writer is surprised that in cranial cases in particular, this method, demonstrated to the Surgical Society by Desplates, has not been more extensively copied. The observation is made that while undoubtedly they are working under the best possible conditions in such a hospital, there is no reason why equally successful results should not be obtained under less favourable conditions.

Lighting.—The question of lighting is, of course, important to the surgeon. It is not in the least fundamental that the operating room should be artificially lighted. Any operating room in which a portable X-ray outfit can be used will do very well, as has been proved by M. Lobligeois, or as it is done constantly by the radiographer of the ninth district in quarters which do not have X-ray laboratories capable of being used as operating rooms. Darkness therefore is not absolutely necessary, as Mauclaire thinks, who sees in the absence of facilities for darkening a limitation to the possibility of extraction under the screen.

The best possible conditions for operating are, of course, those which interfere the least with the usual technique of the surgeon, that is, a proper operating room in broad daylight. Under these conditions the manudiascope of Bouchacourt is exceedingly useful. This apparatus, which is kept fastened to the head and eyes, has a removable screen with a sheet of dark coloured celluloid, with sufficient definition to see, and at the same time keep the eye sensitive for fluoroscoping. Such a diascope is easily constructed out of empty crate boxes, and M. Dessaine, for the Central Radiographic Laboratory at Tours, has made such an apparatus, which is rather better than that of M. Bouchacourt, in that the field is larger. The writer sees no advantage in operating with coloured artificial lights, either red or violet, although the latter is preferable.

A synopsis of the "History of Extraction under the X-Ray" is attached to the article.

R. W.

New York Medical Journal, Dec. 18th, 1915.—Dr. J. W. Squires writes on "The Roentgen Ray Diagnosis of Gastric Lesions." He divides the lesions of the stomach into two groups. The first is that in which permanent alteration of the contour of the organ is present: included in this class are tumours, chronic ulcers, adhesions and syphilis. The second group consists of simple acute ulcers and extra-gastric conditions producing spasmodic defects of the stomach.

In commenting on the similarity of the radiographic appearances in chronic ulcer and in early malignancy, Squires says that our differentiation should not be between malignant and benign lesions but between medical and surgical. When the condition has advanced to a stage sufficient to be called surgical there will be a permanent defect in the shadow contour, stasis and interruption of normal peristalsis. He insists that the recognition of this stage is essential since medical treatment is now useless, and valuable time will be lost unless surgical aid be sought. Even if the lesion be malignant it is not too late for treatment at this stage.

Technique consists of the administration of 70 grammes of barium sulphate suspended in 400 cc. of buttermilk either with a light breakfast or just after the morning meal. Radiographs are taken immediately and at half-hour intervals, or even more frequently if required. If defective filling of the duodenal cap be seen serial radiographs are made of that part. The standard positions for the patient are prone, oblique and right lateral. Screen examinations are made after the plates are finished, a separate meal being administered for the purpose.

Eight points are mentioned to which attention should be directed before making a diagnosis of malignancy; they are placed in the order of their relative importance as follows:—

1. Filling defects. These vary considerably with the type of malignancy; they may be large and scalloped in the medullary type, a small contracted stomach in the scirrhus type, and a small defect resembling that of an ulcer in the papillary type.

In differentiating between true filling defects and irregularities due to the pressure of neighbouring organs, screen examination is useful as the organs can be pushed aside, when the apparent defect may fill out. Under screen observation also spasmodic defects may be smoothed out by palpation, thus demonstrating their true character, or they may be caused to disappear by administering belladonna for several days and then making a second examination. A case is cited in which a filling defect persisted even on palpation yet disappeared under atropine, and the defect proved to be spasmodic. The appearance of spasmodic defects is often different from that of organic lesions in that the outline of the former is usually clear-cut, whilst in the latter it is apt to be diffused.

2. Peristalsis is absent in the involved portion of the stomach, and the waves as a whole are frequently diminished both in force and in number.

3. Mobility of the viscus may be lessened by the formation of adhesions. This point is best observed by palpation under screen observation.

4. Superimposition. This point consists in superimposing serial plates and noting whether the defect remains constant in shape and position.

5. Pain. During screen examination attempts are made by palpation to see whether the site of pain or tenderness corresponds to that of a defect.

6. Changes in the pylorus. The pylorus may be obstructed or it may gape widely open, the explanation of the latter condition being found in secretory changes.

7. The residuum of the meal in the stomach after six hours. This may be large, small, or altogether absent, depending on the condition of the pylorus.

8. The position of the most advanced portion of the meal after six hours is a point of minor importance, but it may assist in diagnosis.

In the diagnosis of chronic gastric ulcer attention should be specially directed to four points:—

1. Permanent irregularities in contour as demonstrated by serial radiographs and the effect of palpation and atropine on them. Occasionally the actual crater of the ulcer

can be seen filled with the opaque substance.

2. Interruptions of peristalsis can be observed during screen examination.

3. The incisura, which is a notch caused by contraction of the circular muscle coat of the stomach. This is sometimes difficult to distinguish from a notch due to reflex spasm, and a useful plan in such a case is to administer atropine hypodermically and examine again in half an hour to see if the defect is still present.

4. Pain located directly in the region of the defect. The pain is always sharp, in contradistinction to that of malignancy, which is duller and more diffuse.

Minor points which should be noted are hyper-peristalsis, hyper-motility, and spasm of the pylorus with delayed emptying.

The diagnosis of simple acute ulcers is rarely made radiographically but the characteristic incisura is sometimes seen, and when present is pathognomonic. These ulcers rarely require operation and are generally recognised as lesions to be treated medically.

The diagnosis of duodenal ulcer is more satisfactory, owing to the fact that its normal anatomical relations are constant. With proper technique there should be no difficulty in demonstrating the normal duodenal cap. The absence of the cap or the presence of a persistent defect indicates ulcer. Diagnostic points are a persistent defect of the cap, sharp localised pain and hyper-peristalsis. If stricture of the duodenum be associated with the ulcer it will result in diminished instead of increased peristalsis.

Extra-gastric lesions which produce reflex spasm of the stomach are irritative or inflammatory conditions of the gall-bladder, appendix, or other organs. Their differentiation from true gastric lesions is sometimes very difficult and requires the use of every one of the preceding diagnostic points.

A collection of illustrations to demonstrate the various points accompanies the article.

H. M. B.

New York Medical Journal, June 17th, 1916.

Writing on the subject of "The Corroborative Diagnosis of Mastoiditis by X rays," Dr. Harold Hays says that, while he does not regard X rays as necessary to prove the presence or absence of mastoiditis and relies on the clinical signs, he finds them of very great assistance in deciding when to operate. He believes that radiography can, by indicating the necessity for operation, prevent the very extensive mischief that is sometimes found.

The technique given is that of Dr. Dixon: the patient lies prone with his head laid on a slope at an angle of 166 degrees with the table. The head is turned to one side and the chin slightly tilted downwards, the pinna being folded forwards. The plate is beneath the head and the tube above, in such a position that the internal and external auditory canals are as nearly as possible superimposed. After one exposure has been made the head is turned to the other side without moving any other part of the body and another plate taken, so that both mastoid areas are secured for comparison.

The normal variations of this area are commented on, as is also the fact that the position of the lateral sinus is usually indicated by the shadow of the anterior margin of its groove. This is judged in relation to the meatus and to the angle it makes with Reid's base line: if the shadow of the groove be at right angles to Reid's line it is very close to or immediately under the posterior canal wall, and as the angle decreases backwards the sinus is farther and farther from the canal. The normal angle may be taken to be between 50 and 55 degrees.

Though the variations of the mastoid are extensive they are usually symmetrical, and special points to be noted are the position of the lateral sinus, the variety of cells in the mastoid, how far they extend backwards, and the extent to which they invade the zygoma in front.

Several cases are included to illustrate the various directions in which Hays received help from radiography.

Case 1.—Acute otitis media: paracentesis: improvement: relapse on the third day with severe pain and profuse discharge, from which staphylococcus aureus was isolated. Hays was in doubt as to whether to operate in a case where there had only been discharge for three days, but the radiograph showed cloudiness of the entire mastoid and operation was performed followed by uninterrupted recovery

The chief advantage of the rays here lay in indicating the necessity for early operation and thus saved the patient a more extensive infection.

CASE 2.—Streptococcal abscess of the ear, with all the clinical signs of mastoiditis: patient begged for operation, but the duration of the case was only three or four days. The radiograph did not show sufficient evidence of trouble to warrant operation so none was performed. Two days later the symptoms disappeared and the discharge ceased at the end of a week. In this case the rays correctly indicated that operation was not required.

CASES 3, 4, 5, and 6 had all longer histories In three of the four cases there was discharge, and in the fourth there was deafness and a bulging drum. X rays demonstrated the necessity for operation in each case and they all made subsequent uneventful recoveries. In two of the cases the entire mastoid was seen to be destroyed, both in the radiograph and at operation.

CASE 7.—Pneumococcal otitis media, which subsided after four days local treatment but became reinfected by streptococci. There was much pain and slight discharge. Numerous incisions had been made with no definite effect: radiograph showed cloudiness of the mastoid and recovery followed operation.

CASES 8, 9 and 10 were children who had mild grades of infection of the class in which a continuous aural discharge is so often attributed to the presence of enlarged tonsils and adenoids, but the otorrhœa does not cease after their removal. The children in this class of case do not seem ill, though at times they appear languid, and the discharge is usually mucoid and stringy rather than purulent. In all of these three cases operation was indicated by the radiographs and rapid recovery followed. Hays considers that operation in this class of case is important in view of preserving the child's hearing.

CASE 11.—History of acute otitis media and incision of the drum two months previously: slight discharge from ear and tenderness over mastoid. Radiograph showed cloudiness of the mastoid, and, on operation, the bone was found to be hard and sclerotic but there was no pus. This case is included to show the possibility of the X-ray plate being misleading where the bone is sclerotic, resulting in opacity of the area, which may appear to be due to purulent mastoid cells even when such a condition is absent.

H. M. B.

NOTES AND ABSTRACTS.

RADIOLOGY.

On the Use of Thorium Salts in Urology and Roentgenology. — J. EDWARD BURNS, M.D., Johns Hopkins Hospital, Baltimore (*The American Journal of Roentgenology*, October, 1916).—The writer, commenting on the use of solutions for outlining the ureters and pelvis of the kidney, notes that a true solution is to be preferred to the colloidal solutions and suspensions of the salts of metals hitherto used, some of which sedimentate on standing and some of which are toxic and irritating. Such a solution should be non-toxic, non-irritating, quite opaque to the X-ray, should give clear delineation, should possess a marked degree of fluidity, it should be non-staining, and should be inexpensive. Owing to its great atomic weight, thorium salts were suggested. The nitrate and chloride are unsuitable, first, because of their acid and their stringent properties; second they precipitate unsoluble salts in contact with urine. They are valuable for outlining the finest capillaries and ducts in pathological specimens, which, after injection, are fixed in Kaiserling's solution, which precipitates the thorium.

A solution, eventually adopted, consists of double citrate of soda and thorium, together with an excess of sodium citrate and some sodium nitrate. This solution is prepared as follows :—

To make 100 cc. of a 10 per cent. solution,

10 grammes of thorium nitrate are dissolved in as little distilled water as possible. To this solution, kept hot on a water bath or steam bath, are added 30 cc. of a 50 per cent. solution of sodium citrate, the additions being made in small quantities, and care taken to shake the solution thoroughly after each addition. At first, after the addition of the citrate solution, a white precipitate is formed, which later becomes granular and finally dissolves on the addition of all the citrate solution. This solution is then made neutral to litmus by the careful addition of a normal solution of sodium hydroxide, and made up to the required volume of 100 cc. with distilled water. On filtration a clear limpid solution is obtained, which, when sterilized by boiling or steam under pressure, is ready for use. The stability of the solution is unaffected by sterilization.

(*Journal of the American Medical Association*, June 28th, 1915, Vol. LXIV, page 2126). —For pyelograms, a 15 per cent. solution of the above is used. For cystograms a 10 per cent. solution is quite satisfactory. It has the property, either by absorption by calculi or by reason of its density, of accentuating shadows of calculi in the urinary tracts, when they are not ordinarily seen in X-ray plates. The solution is clear and watery, and plates made a few minutes after discontinuing the injection show no evidence of a shadow. It is absolutely non-irritating. It is not bactericidal and must therefore be sterilized and kept sterile while being used. Injection is by gravity from a burette (with rubber connection and nozzle for the end of the ureteral catheter), held slightly above the level of the patient. The danger of the syringe is mentioned.

Two hundred cases have been radiographed in the last 13 months without any untoward events. The largest amount used was 600 cc. of a 10 per cent. solution, introduced into the bladder, ureters and renal pelves of a boy 12 years of age. There was no change in the phenolsulphonephthalein output or blood urea content, nor any interference with kidney function in any of the cases. For pyelograms, from 5 to 150 cc. of a 15 per cent. solution, and for cystograms, from 30 to 930 cc. of a 10 per cent. solution. Attention is drawn to the danger of using *any* solution injected into the renal pelves or ureters in a class of cases where the phenolsulphonephthalein output for two hours is reduced and the blood urea content well above normal. Where an X-ray of a kidney in such a case is absolutely necessary, only one side should be done at a time and an interval of several days allowed to elapse before the other side is attempted. The solution costs about one-third the price of collargol.

R. W.

Routine Technique of Barium Diagnosis.—L. L. Jones, M.D., Battle Creek Sanitarium (*American Journal of Roentgenology*, October, 1916).—Dr. Jones brings out the importance of the standardisation of the gastro-intestinal tract, as explained by J. T. Case, for the Royal Society of Medicine in London, 1912, and advocates the barium sulphate meal, consisting of 2¼ ounces of barium sulphate, ¼ of an ounce of which is given in one-third of a glass of water. As this salt is absolutely neutral and unaffected by organic solutions, the pyloric sphincter is unaffected, and the whole duodenum effectively outlined. The remaining two ounces are divided equally into a glass of hot malted nuts ("proprietary food") and a glass of Oriental clotted milk. This meal averages about sixteen ounces. He believes that to obtain a correct interpretation of a pathological condition in the upper part of the colon, laxatives should not be used, and quotes Case as showing spasticity in the distal half of the colon, after the administration of laxatives, and absence of spasticity in the identical bowel when no laxatives had preceded the test.

Attention is drawn to the importance of giving the meal at the usual breakfast hour. The first part in the vertical position, the second part lying down on the right side. Pressure on the greater curvature of the stomach towards the pylorus, the patient quickly turning on his back, holds the barium in the pyloric end of the stomach, filling the bulb and facilitating its study. If the results are unsatisfactory, the process is repeated in two and a half hours.

Four and a half hours after the test break-

fast, the motility is determined, the amount of residue, if any, being estimated and the hour for lunch set, so as to insure the stomach being empty of the barium meal. A normal period of six hours is allowed.

Nine and a half hours after the first meal the third observation is made. A residue in the stomach will show the amount of barium remaining when the patient had lunch. Any residue in the ileum gives a fair estimate of the amount of ileac stasis, the terminal ileum being normally empty in nine and a half hours. At this time all the barium should be in the colon as far as splenic flexure

Twenty-six hours after the meal the colon is normally partially empty. A trace is found in the cæcum and ascending colon. The remainder of the colon is densely filled to the ampulla

Fifty hours after the meal, any residue in the colon furnishes an estimate of the amount of colonic stasis. Colon should be cleared and the examination finished. In case of considerable residues further observations are made at the seventy-fourth or even the ninety-eighth hour.

The next proceeding, the injection of the opaque enema, is preceded by three small warm enemata at fifteen minute intervals before breakfast, and a note is made that this procedure is more effectual than one large enema. It is important that this enemata should be given not less than two or more than three hours before the opaque enema. The colon tube is condemned as being a failure and unnecessary. Before the enema is injected, the screen examination is made for residues, especially in or above the appendix for diverticula of the colon.

The enema consists of a warm mixture of barium sulphate and gum tragacanth.

A printed list of instructions is furnished to each patient, warning them :—

(1) To take no laxatives or enemata for at least twenty-four hours before the barium meal.

(2) Not to take any food, drink or medicine on the morning of the examination.

(3) To avoid eating or drinking until the stomach is empty of the meal, usually at noon, but definite instructions given in each case.

(4) Not to take any laxatives or enemata during the first two days of the test.

(5) Women patients save inconvenience by wearing kimonos.

The procedure outlined above is recommended as a reliable basis for comparison.

R. W.

Papaverin in the Differential Diagnosis between Spasm and Stenosis of the Œsophagus.—ALBERT E. STEIN (*American Journal of Roentgenology*, October, 1916).—The writer reports an obstruction about seventh or eighth thoracic vertebra when the patient swallows the bismuth paste. In order to determine the cause of the obstruction, a subcutaneous injection of 0.03 gram. of papaverin was given. (This preparation has the effect of decreasing the tension of the non-striated muscles, especially in gastro-intestinal affections.) Within fifteen minutes a spasm had been relieved and the obstruction disappeared. Its use was continued as a therapeutic measure. R. W.

RADIOGRAPHY.

Shrapnel Ball in the Heart.—(*Journal de Radiologie et d'Electrologie*, Vol. I., January-February, 1916.)—Two interesting cases of foreign bodies in the heart are recorded. First, by R. Ledoux-Lebard, who remarks that while a certain number of cases of foreign bodies in the heart have been reported, very few have been accompanied by satisfactory radiographs, owing to the lack of sufficient powerful installations capable of taking a picture in at least one-twentieth of a second, and Finzi's cases are quoted (Nos. 43 and 44, the *Journal of the Roentgen Society*, 1915). Moreover, in his case, foreign body was imbedded in the heart muscle, while in the case quoted by Lebard, shrapnel ball was free in the cavity of the right auricle. Two views were taken, one from before backwards and the other oblique. The apparatus used was a one-flash coil and the definition is splendid. Exposure was probably one-fiftieth of a second. On screening, foreign body was seen to travel in an elliptical orbit, of which the greater and vertical axis was about two centimetres. Further particulars of this and five other similar cases are promised in a subsequent communication.

Second case is reported by G. Barret, occurred in the service of Dr. Vouzzelle in his ambulance unit. The difficulty of localization was extreme, owing to the amplitude and rapidity of its movement, and could only be properly seen for a minute period of time at either end of its excursion. It could only be clearly made out in the lateral position in the line of its trajectory, which was almost transverse. The two ends, about four centimetres apart, were situated to the right of the sternum, a short distance below the lower cardiac image. He notes that the usual procedure of localizing by means of two radiographs, after the method of Hirtz and others, was extremely difficult of application. Radiographs would have had to have been instantaneous, and even in the case of success, the varying position due to its mobility would have vitiated the result. The method of localization adopted was that of plotting the normal ray from two positions and obtaining the depth of the surveys of each. This, in connection with the screening, localizes the foreign body in the inferior cardio-pericardiac mass. On operation pericardium was found to contain an abundant extravasation of blood, and the foreign body could be easily felt in the cavity. Every attempt to hold the heart long enough to incise resulted in an alarming attack of syncope and the attempt was abandoned. The patient died three days after.

R. W.

RADIO-THERAPY.

Robert T. Frank (*Medical Record*, Sept. 30th, 1916).—The author discusses the indications for and limitations of the use of X rays in uterine hæmorrhage. The action is mainly on the ripening ovarian follicles, and possibly in a small degree on the uterus as well. There is the advantage that in young women the bleeding can be considerably toned down without destruction of the uterus.

This treatment should be used if there is renal or cardiac or other contra-indication to operation. It should not be employed if there is any suspicion of malignant disease, other tumours, or any similar complication.

N. B.

New York Medical Journal, May 27th, 1916.—Dr. Russell Boggs, referring to the treatment of tubercular glands, comments on the increasing frequency with which these cases are coming into the hands of the radiologist for treatment, and considers that the results of irradiation are usually better than those of surgical operation.

Technique differs from that used in malignant conditions, and operators who expect to obtain improvement by administering a small number of massive doses are doomed to disappointment. The explanation of this difference may be found in the fact that in malignant conditions the effects of irradiation are produced almost entirely by purely local action, whereas in tubercular adenitis the results suggest that, during the destruction of the diseased masses, autogenous vaccines are set free to exert their curative influence. This may be deduced from the disappearance of a tubercular lesion in one part of the body as the result of irradiation of a diseased mass in a totally different part. In a few cases Boggs found that tubercle bacilli disappeared from the sputum during a course of treatment for enlarged glands.

As the result of treatment the gland may calcify or may become atrophied into a small nodule of fibrous tissue.

Tubercular adenitis is slower in responding to treatment than are other glandular enlargements, such as Hodgkin's disease or lymphosarcoma, but, on the other hand, the end results are better and there is not such a tendency to relapse. This is probably due to the purely local effect of the rays in the latter conditions as compared with the general systemic effect they exert in the former.

H. M. B.

RADIUM-THERAPY.

W. B. Aikins ("Presidential Address, Ontario Medical Association," *Medical Record*, Aug. 19, 1916).—The very great field of usefulness of radium in the treatment of exophthalmic goitre is discussed in the light of the author's own experience and that of many others. He has proved that the use of radium rays causes the vascularity of the thyroid gland to be diminished and its secretion to be reduced.

N. B.

Howard A. Kelly and Curtis F. Burnham (*Medical Record*, Sept. 30, 1916).—The use of radium in sufficient quantities greatly increases the chances of permanent recovery from utero-vaginal cancers. In a series of 327 patients of all grades of the disease, from borderline to quite inoperable, 20 per cent. were apparently cured. In others the symptoms were much alleviated and the health improved. N. B.

ELECTROTHERAPY.

G. Betton Massey (*Medical Record*, Sept. 30, 1916).—The author describes the results of treatment of malignant tumours by an improved bipolar method of ionisation. He inserts a number of zinc needles in the outer limits of the growth, and the inactive needle, also of zinc, in its centre. Currents are applied under anæsthesia for any time up to 30 minutes, and of a strength of 500 milliamperes upwards. Subsidiary applications may be required for outlying patches of growth which escape at first. The cases quoted are in elderly people, and are mostly advanced and inoperable, yet greater or less improvement is claimed in each. N. B.

ELECTRO-DIAGNOSIS.

Elementary Reactions in Electrodiagnosis. —L. Delherm (*Journal de Radiologie et d'Electrologie*, II. 4, July-Aug., 1916).—A detailed discussion of the several reactions of muscles to the faradic and galvanic currents. Decreased faradic excitability, though difficult to estimate, should be accurately investigated. No failure to respond should be deemed complete until "latent excitability" has been sought by the method of voltaisation. A direct current is passed from the appropriate spinal centre to the end of the limb, and while this is running the doubtful muscle is tested by the interrupted current in the usual way, or by the bipolar method.

Tiring after prolonged treatment or testing is normal, but is marked, and forms the reaction of Benedikt-Jolly, in the recovery of some cases of neuritis. It is early seen in myasthenia, of which it is pathognomonic.

A sluggish contraction—Faradic, R.D.—has been noticed by several observers.

The myotonic contraction is only found in a small group of cases, myopathies, Thompson's disease, etc.

Figures are given for the normal excitability of many muscles to the galvanic current.

A quick K.C.C., with slow A.C.C., has been noticed by several, from Erb onwards, but is rather exceptional. It probably marks a stage in R.D., in which the sarcoplasm gives its typical response to the positive, while enough healthy striped fibre is left to reply to the negative in the usual way.

The slow contraction of Remak is one of the pivots of electrodiagnosis, and all the theories are discussed in this connection.

The reaction of Erb—inversion of polar formula—is of a quite secondary importance to the slow contraction, and may vary artificially by slight variation of the testing electrode.

The theoretical explanation of the real and virtual polarity of the stimuli is relied upon.

The longitudinal reaction (of Huet, Doumer, and Ghilarducci) is no guide to the degree of R.D., and only implies a serious alteration of the muscle consequent on nerve injury.

The reaction of Geigel (often called that of Rich by a typographical error) is due to compression and vascular disturbance. It consists in a greater contraction at "break" than at "make," when the nerve trunk is stimulated. There is no change in the muscle response, and the phenomenon is transitory.

Another form is seen on stimulation of the muscle itself, is equivalent to hyperexcitability, and is long lasting. This implies marked degeneration of recent origin.

Galvanatonus is probably common as a stage in R.D., it occurs in myopathy in muscles that are not yet clinically involved, and is very common in Thompson's disease.

N. B.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

ELECTRICAL TESTING OF MUSCLE AND NERVE.

THE large number of cases of paralysis following gunshot injury of nerves that are constantly arriving at the hospitals has given prominence to the subject of the electrical testing of muscle and nerve, and to the question of the value that is to be attached to the results of such testing for diagnosis and prognosis.

Those who have had experience of the subject are aware of the sources of error in electrical testing, and of the uncertainty that prevails in the interpretation of the results. The need for more exact methods of testing has long been felt, and the plan of using condenser discharges was introduced as a means of applying electrical stimuli of known strength and duration. There are, however, fallacies that underly the use of condenser discharges when exact results are desired. But whether the condenser method is used or the faradic and galvanic method, it is doubtful whether the reactions of the *muscles themselves* give any information regarding the state of nerve when once R.D. has developed.

The paper by Dr. Adrian, in the present number of the ARCHIVES, is an important contribution to the study of the electrical testing of muscle and nerve. The author has applied to the human subject the method that has been used during recent years by Keith Lucas, at Cambridge, in his researches on the mechanism of electrical excitation of muscle and nerve in amphibians. A galvanic current of known and variable strength and duration is used. As an index of the condition of muscle in a normal or denervated condition, Dr. Adrian makes use of a time constant known as the *chronaxie*. The chronaxie is an expression of the quickness of the excitation process. It is very constant for muscle with undamaged nerve, and has a very short duration. For denervated muscle it is very much longer. There is a wide gap between the chronaxies of normal and denervated muscle, and there is apparently no chronaxie of any intermediate duration to fill the interval. Dr. Adrian shows curves indicating the relation between current strength and current duration for normal and denervated muscle, and it will be seen that they show no gradual transition from one to the other—the change being abrupt.

Dr. Adrian does not make use of the customary terminology in reference to electrical reactions, but if we regard a muscle with normal reactions as one with a short chronaxie, and a muscle with *complete* R.D. as one with a long chronaxie, the reaction *partial* R.D. would indicate a mixture of muscle fibres, some showing normal reactions, others with the reactions of degeneration. It would appear that there is no basis for the subdivision of partial R.D. into groups, each requiring its minimum duration electrical stimulus. The condenser method of testing appears to render such subdivision justifiable, but Dr. Adrian points out the fallacy of this method as commonly applied.

In the latter part of the paper Dr. Adrian discusses the results of his observations and their bearing upon the subject of electrical testing and treatment of paralysis.

THE PRICE OF THE "ARCHIVES."

WE regret having to announce that the publishers find it necessary to increase the price of the ARCHIVES. The annual subscription from June, 1917, will be 21s. to all subscribers ($5.00 Postal Union), the cost of individual copies being 2s. 6d.

PHYSIOLOGICAL BASIS OF ELECTRICAL TESTS IN PERIPHERAL NERVE INJURY.

By E. D. Adrian, M.R.C.P., Fellow of Trinity College, Cambridge, Temporary Captain, Royal Army Medical Corps.

The method of testing by means of the electrical reactions in cases of peripheral nerve injury has been in use for twenty years and more. From time to time the apparatus of the test has been modified, and stress has been laid now on one and now on another of the phenomena which go to make up the classic reaction of degeneration. The importance of the polar reversal has yielded place to that of rapidity of contraction, condensers have replaced the faradic and galvanic current, and yet it is scarcely an exaggeration to say that, as far as any relevant diagnosis or prognosis is concerned, no advance has been made since Erb's work first appeared. The position has been stated clearly and pitilessly by Dr. Burke in a recent number of this journal,[1] and his analysis makes it easy to understand how it has come about that neurologists are more and more inclined to rely on changes in sensation, tone, nutrition of muscles, etc., and having made their prognosis on these grounds to leave the electrical reactions to those who are interested in them.

However, although the practical results of electrical testing are still very much where they were twenty years ago, it is a mistake to suppose that the theoretical side of the subject has been equally stationary. During the past fifteen years physiologists have been investigating the conditions necessary for the electrical stimulation of isolated muscle and nerve, and since the war their results have been applied to the study of the electrical reactions in man. The outcome of this is that we are now in a position to state exactly what we can hope to find out from these reactions and to consider the best method of testing them. To anticipitate, it may be said that as far as prognosis is concerned there is little to be gained by the use of elaborate methods and technique, and that the only practical points we can decide are (*a*) whether the nerve is or is not in functional continuity with the muscle, and (*b*) whether the muscle will be still capable of contracting when the nerve has regenerated.

The recent advances in our knowledge of the mechanism of electric stimulation in isolated muscle and nerve preparations are due almost entirely to the work of Keith Lucas in England and of Lapicque and his pupils in France. A *résumé* of this work, in so far as it touches on the subject of electrical testing, has been published by Laugier,[2] and more recently by Tinel[3] and by the present writer[4]; for this reason it will be considered as briefly as possible. The important facts are as follows. If we take a simple excitable structure, such as an isolated nerve fibre or striated muscle fibre, and use as

1 Archives of Radiology and Electrotherapy, July, 1916.
2 "Biologie Medicale," p. 89. 1914.
3 "Les Blessures des Nerfs," Masson et Cie, 1916. Page 50.
4 "Brain," XXXIX., p. 1. 1916.

stimulus the simplest and most easily adjusted form of current, namely a galvanic current of known strength and known duration, we find that there are two limiting factors which determine the success or failure of the stimulus. These are (1) a certain minimal strength, and (2) a certain minimal duration. However strong it may be the current will not excite if its duration is shorter than a certain time, and its strength cannot be reduced below a certain level, however the duration may be prolonged. Within these limits the necessary strength and duration are related in the following way. For all durations which are long compared with the minimal duration the strength of current required to excite remains constant at its minimal value. As the minimal duration is approached the strength must be increased, and the increase becomes more and more rapid as the duration is reduced. Fig. 1 shows this relation graphically, ordinates giving current strength and abscissæ the corresponding duration.

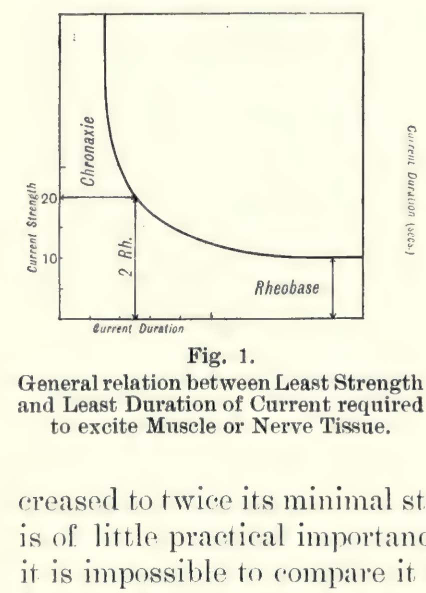


Fig. 1.
General relation between Least Strength and Least Duration of Current required to excite Muscle or Nerve Tissue.

This form of curve has been found for every excitable tissue hitherto investigated. Various equations have been proposed to describe the curve, but for practical purposes it may be defined by two factors which Lapicque has called the rheobase and the chronaxie. The rheobase is equal to the strength of current required to excite when the duration is infinite (Rh. in Fig. 1), and we may consider it as depending on the absolute excitability of the tissue in question. The chronaxie depends on the rapidity of the excitation process, and it is equal to the duration at which the current must be increased to twice its minimal strength, *i.e.*, to twice Rh. in Fig. 1. The rheobase is of little practical importance as an index of the condition of the tissue, for it is impossible to compare it in different cases with any profit unless the conditions of stimulation are very accurately controlled as to resistance, current flow per unit area, etc. On the other hand, the chronaxie can be measured without any of these precautions, since we need only determine the duration at which the current strength must be twice the threshold value, and the disposition of electrodes, resistances, etc., does not matter. It is found to be remarkably constant for similar tissues examined under similar conditions of temperature, perfusing fluid, etc. Further, it shows very great variations in different types of tissue. For instance, in the medullated nerve of the frog its value is always in the neighbourhood of ·0005 sec. at 15° C. In the frog's striated muscle it is ·007 sec., and in its ventricular muscle ·45 sec.

It appears then that in the chronaxie we have a constant which is definitely related to the state of the excitatory mechanism of the tissue, and this has been abundantly confirmed both from the empirical and the theoretical standpoint. Its value allows us to predict the reaction of the tissue to currents

of any form and duration, and gives us some idea of the time relations of most of the phenomena taking place in the tissue, *e.g.*, the rate of conduction, the rate of recovery, etc., in addition to the rate of excitation. In fact, if it is necessary to single out any one constant which will suffice to indicate the condition of an excitable tissue, the chronaxie is by far the most valuable constant to select.

It is naturally an easier matter to determine the chronaxie alone instead of the whole curve relating current strength to current duration, and therefore we shall deal first with the results obtained from measurements of the chronaxie in human muscles under different conditions of nerve injury.

The Chronaxie of Human Muscles.—These measurements have been carried out by Lapicque,[5] Laugier,[6] Bourguignon,[7] and others. They find that when the nerve is intact the chronaxie, measured with the cathode applied to the motor point of the muscle or to the nerve supplying it, has a value varying from ·00015 to ·0006 sec., according to the muscle in question. Working independently of them I have obtained results which are in very close agreement with theirs, namely, ·00012 to ·0008 sec. for muscle with intact nerve supply. In muscles whose nerve supply is completely destroyed the chronaxie is very much longer, and is usually of the order of ·01 sec. Here, too, the results of different observers agree very well together. Typical values for muscle, with intact and with degenerated nerve supply, may be seen in Table I. These figures are taken at random from various cases of peripheral nerve injury or disease at different periods from the onset of the condition. It will be seen that in every case the chronaxie for muscle with degenerated nerve supply is at least 20 times as long as the value with intact nerve, and that it may be 100 times as long.

TABLE I

Case.	Duration since Onset.	Chronaxie. Affected Side.	Chronaxie. Intact Side.
Divided Sciatic (tibialis anticus)	9 months	·011 sec.	·00012 sec.
Divided Sciatic (tibialis anticus)	1½ months	·013 sec.	·00025 sec.
Divided Extl. Popliteal (tibialis anticus)	5 months	·013 sec.	·00016 sec.
Poliomyelitis (tibialis anticus)	2 months	·016 sec.	·00016 sec.
Poliomyelitis (tibialis anticus)	1½ months	·013 sec.	·0005 sec.
Neuritis (deltoid)	4 months	·008 sec.	·00016 sec.
Polyneuritis (tibialis anticus)	3 months	·022 sec.	·0004 sec.
Bell's Palsy (orbicularis palp.)	4 months	·010 sec.	·00024 sec.
Bell's Palsy (orbicularis palp.)	1½ months	·030 sec.	·0005 sec.

5 "Comptes Rendus." CLXI. P. 643. 1915.
6 *Loc. cit.*
7 "Comptes Rendus." CLXIII. P. 68. 1916.

Whatever interpretation may be put upon these results it is easy to trace their connection with the classical methods of investigation with faradic and galvanic currents. The faradic coil gives a series of induced currents of very short duration frequently repeated. The effective duration of each shock varies with the dimensions of the coil, but it is of the order of ·001 sec. The galvanic current is a current of long duration. Its exact length is uncertain when the circuit is made and broken by hand, but is probably never much shorter than half a second. Now in human muscles with intact nerve supply the chronaxie is about ·0002 sec.; that is, the duration of the current may be reduced to ·0002 sec., and it will be still capable of exciting the tissue if its strength is twice the threshold value. Consequently the brief current from an induction coil lasts quite long enough to excite. On the other hand, when the nerve has degenerated the current strength must be doubled at a duration of ·01 sec., and at shorter durations it must be increased still further. As will be seen from the actual curves[8] the increase tends to infinity at about ·002 sec., and a current of shorter duration than this will not excite, however strong it may be. This change in the time constants will not alter the effect of the long galvanic current, but it will evidently prevent the short faradic current from exciting. Thus the muscle reacts to galvanism but not to faradism.

This explanation of the failure of faradic currents owing to the short duration of the discharge has been recognised for many years, and the present results only help to emphasise the importance of the current duration in determining the success or failure of the stimulus; they give no indication as to the reason for the slowing of the time factor when the nerve degenerates. To decide this question, which lies at the root of the whole subject of electrical testing, we have to consider the complete curve relating current strength to current duration instead of contenting ourselves with the measurement of the chronaxie alone.

Before dealing with these curves it will be as well to indicate briefly the technical details involved in their measurement and in that of the chronaxie.

Method of Investigation.—The apparatus consists essentially in a potentiometer arrangement for varying the potential difference between the electrodes from 10 to 100 volts, and a mechanical contact breaker capable of delivering currents varying in duration from ·0001 sec. to ·05 sec. The pendulum or spring contact breakers devised by Keith Lucas[9] for physiological work are admirably suited to this, and I have always employed the Lucas pendulum.[1] Lapicque uses a rotating arm contact breaker driven by a falling weight. Bourguignon has been able to measure the chronaxie by the use of condenser discharges, but the method is too complicated to allow of the determination of more than a few points on the curve.

As regards the electrodes the simplest method consists in using as cathode a small pad closely applied to the skin by a bandage, and as anode a large pad also fixed firmly in some indifferent region. This is quite satisfactory in practice, for the strength of current needed to excite at a standard duration does not change by more than 5 per cent. during a series of measurements lasting half an hour or more. In some cases where there is a liability to error from

8 Figs. 2 and 3, p. 383.
9 "Catalogue of Physiological Instruments," Cambridge Scientific Instrument Co., 1914.
1 *Journal of Physiol.*, XXXVII., p. 460, 1908.

current spread to neighbouring muscles, it is better to use as cathode a small platinum needle thrust into the substance of the muscle. This allows a much more exact localisation of the stimulus, and the movement of the needle gives a clear indication of contractions too weak to cause any obvious deformation of the skin surface.

In constructing a curve the first step consists in determining the least strength of current needed to give a contraction when the duration is several seconds. This is spoken of as the strength at infinite duration, since any further increase in duration is not likely to affect the result. To determine the chronaxie the current strength is doubled and its duration is reduced until the muscle just ceases to contract in response to it. The chronaxie is the shortest duration at which a contraction is obtained with this strength. The rest of the curve can be mapped out either by varying the current strength and finding the least effective duration corresponding to each strength, or else by varying the duration and finding the least effective strength. From time to time the strength at infinite duration is redetermined to make certain that the excitability of the tissue has not altered during the experiment.

In expressing results the strength at infinite duration is given the value 10 and other strengths are expressed as multiples of this. There is no need to measure the absolute strength of the current since we are concerned only with the relation between the strengths needed at different durations.

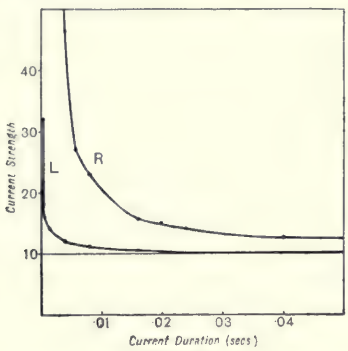


Fig.2.
Reaction of Right and Left Tibialis Anticus in a case of complete division of the right sciatic of six months duration.

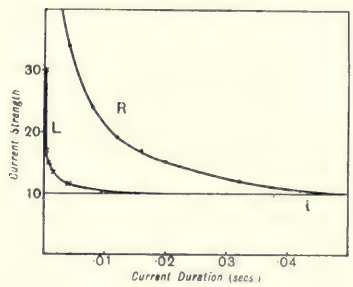


Fig. 3.
Reactions of Right and Left Orbicularis Palpebrarum in a case of right sided Bell's Palsy, two months from onset.

The Strength-Duration Curve of Human Muscles.—Figs. 2 and 3 may be taken as typical curves for human muscle with intact and with degenerated nerve supply. Fig. 2 shows the strength-duration curve of the tibialis anticus in a patient whose right sciatic nerve had been shot through six months previously. The curve marked L is that for the left leg where the nerve supply is intact, and that marked R is for the right leg where the nerve has degenerated. In Fig. 3 the curves are those of the right and left orbicularis palpebrarum in a case of right-sided facial paralysis two months from the onset and showing no signs of recovery. These figures show the great change in the time factor when the nerve degenerates, the chronaxie falling from ·0003 to ·012 sec. in the sciatic case and from ·00024 to ·010 sec. in the facial palsy.

We have now to decide what happens to the rapid curve when the nerve begins to degenerate ; how it becomes transformed into the slow curve, and how this regains the normal time relations when the nerve regenerates again. Figs. 4, 5, and 6 are typical examples of the curves determined in cases where

the nerve is in process of degeneration or regeneration. Fig. 4 is from a case of facial paralysis 12 days after the onset, and Figs. 5 and 6 are from cases of acute anterior poliomyelitis with incomplete paralysis of the tibialis anticus.

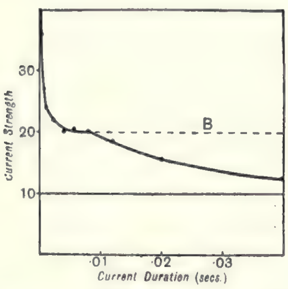


Fig. 4.
Reaction of Orbicularis Palpebrarum in a case of Bell's Palsy, 10 days from onset.

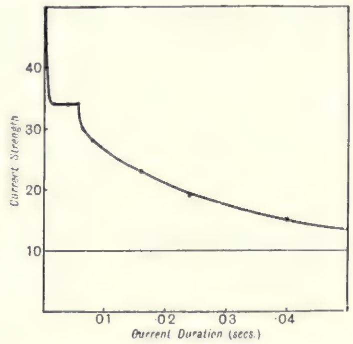


Fig. 5.
Reaction of Tibialis Anticus from a case of Acute Anterior Poliomyelitis, 3 months from onset.

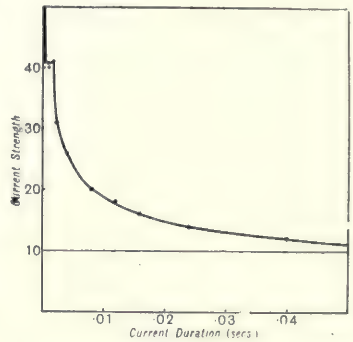


Fig. 6.
Reaction of Tibialis Anticus from a case of Acute Anterior Poliomyelitis, 1½ months from onset.

It will be seen that all these curves are complex; they are made up of a steep, sharply bent curve when the current strength is high and the duration short, and a slower and more gradual curve when the duration is longer and the strength less. The time constants of these two components of the curve are found to agree very closely with the average values for muscle with intact and with degenerated nerve supply. For instance, in Fig. 4, the lower part of the curve has a chronaxie of ·008 sec., and the upper part, if we consider it to arise from the rheobase marked B in the figure, has a chronaxie of ·0003 sec. This is shown more clearly in Fig. 7, which gives the curve in Fig. 6 on a more extended time scale and also typical curves for normal and for denervated muscle. It is evident that the complex curve in Fig. 7 is made up of two curves, having the time constants of normal and of denervated muscle respectively. These complex curves are found in every case which does not give either the simple curve with the short chronaxie typical of intact muscle (·0005 sec. or less), or else the simple curve with the long chronaxie of denervated muscle (·008 sec. or more). At no stage of degeneration or regeneration has a simple curve been found with a chronaxie of some intermediate value—say ·003 sec. We must conclude, therefore, that there is no gradual transition from the rapid to the slow curve as the nerve degenerates. Instead of this we have a period in which both curves are found together, and the transition consists in one curve becoming more and more prominent to the ultimate exclusion of the other.

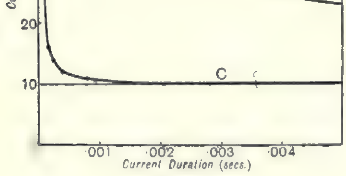


Fig. 7.
Reaction of Tibialis Anticus
A. After complete division of the Sciatic.
B. Recovering from Acute Anterior Poliomyelitis.
C. With intact nerve supply.

This transition may be seen very clearly in Fig. 8, which gives the whole history of a case of facial paralysis from onset to fairly complete recovery. During the first eight days after the loss of voluntary power the curve remains absolutely unchanged. On the 12th day a double curve is obtained, the

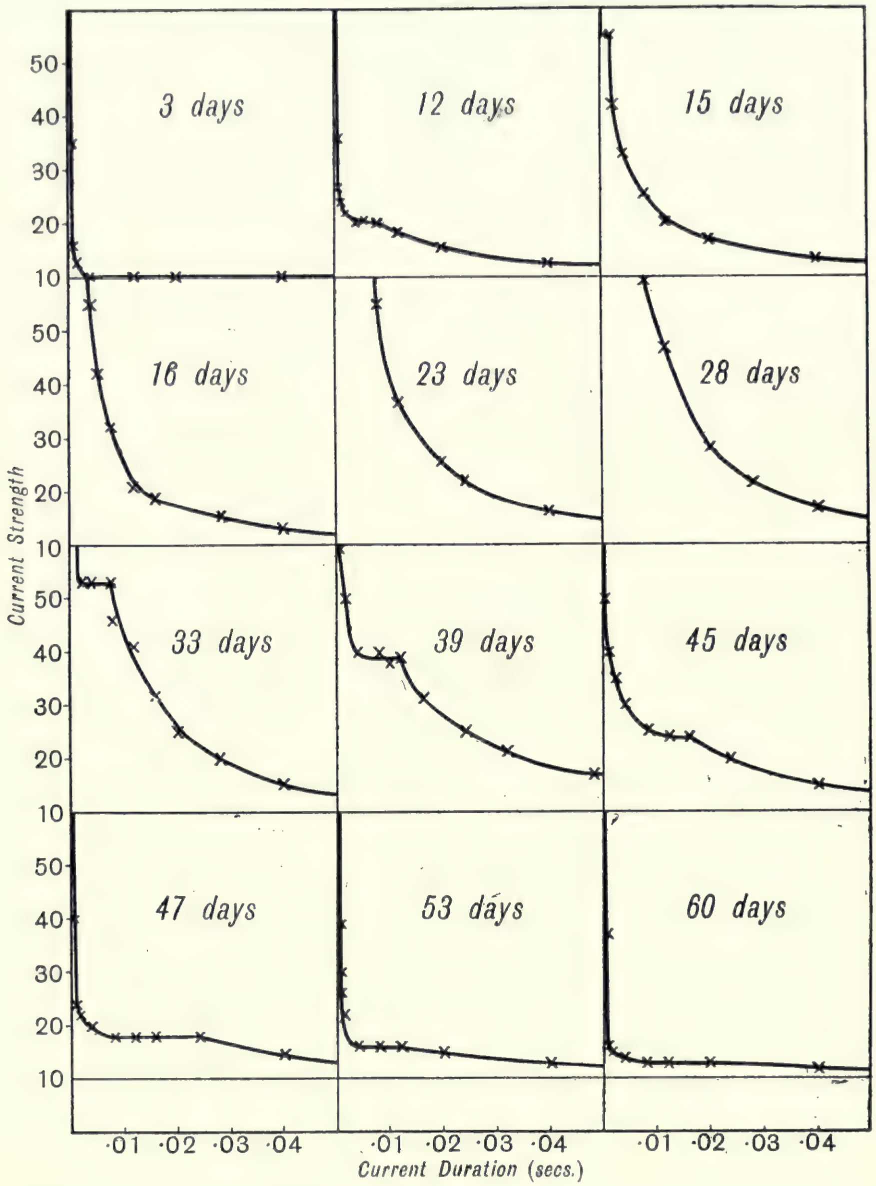


Fig. 8.
Facial Paralysis (peripheral). Reactions of Orbicularis Palpebrarum, from onset to recovery.

discontinuity occurring when the current strength is 20. On the 15th day the rapid curve has been almost entirely replaced by the slow, but it is still possible to detect a break in the curve at a current strength of 55, and with greater strengths than this the curve is of the rapid type. On the 16th day no discontinuity can be found and the curve is of the slow type throughout.

The chronaxie of the slow curve becomes gradually longer and longer until the 33rd day, when the rapid curve reappears at a current strength of 50. The first suggestions of returning voluntary power had appeared a day or two before, but it was not possible to say for certain that any power had returned until the 35th day. After the 33rd day the rapid part of the curve appears at weaker and weaker current strengths and eventually it completely replaces the slow curve about 60 days after the onset of the paralysis.

The different values of the chronaxie are set out in Table II. in two columns, corresponding to the rapid and the slow curve. It will be seen that the chronaxie of the rapid curve alters very little, whereas that of the slow curve becomes gradually longer and longer until the moment when the rapid curve begins to appear again.

TABLE II.

Facial Paralysis, peripheral type.	Reactions of Right Orbicularis Palpebrarum. Chronaxie.	
Days after onset.	Rapid Curve.	Slow Curve.
3	·0005 sec.	—
5	·0005 sec.	—
8	·0004 sec.	—
12	·0005 sec.	·008 sec.
15	·0004 sec. (?)	·012 sec.
16	—	·014 sec.
23	—	·030 sec.
28	—	·032 sec.
33	·0075 sec. (?)	·028 sec.
37	·0075 sec.	·032 sec.
39	·0005 sec.	·033 sec.
41	·0005 sec.	·032 sec.
45	·0004 sec.	·025 sec.
47	·0003 sec.	·017 sec.
55	·0003 sec.	·011 sec. (?)
60	·0004 sec.	—

The explanation of these curves is simple enough. Evidently we have to deal with two distinct excitable mechanisms, one with a short time factor and one with a long. When the nerve is intact the current which is just strong enough to cause a contraction takes effect on the rapid mechanism alone. It is quite possible that strong currents may excite the slow mechanism as well, but the effect of this would be masked by the greater excitability of the rapid mechanism. As the nerve degenerates, the rapid mechanism needs stronger and stronger currents to excite it, and at weak strengths and long durations the slow mechanism comes into play. Eventually the rapid mechanism becomes completely inexcitable and the current takes effect on the slow mechanism alone. When the nerve regenerates, the rapid mechanism appears again. At first it requires very strong currents to excite it at all, but as time goes on it becomes more and more excitable and finally it replaces the slower mechanism completely.

Since the rapid curve disappears when the nerve degenerates and reappears when it regenerates, we have a *prima facie* case for assuming that the rapid mechanism may be identified with the nerve fibre and the slow mechanism

with the muscle fibre. When the nerve supply is intact the current takes effect on the nerve, and short durations are effective on account of the short time constants of the nerve. When the nerve has degenerated the current can only take effect on the muscle fibre directly and longer durations are necessary. This amounts simply to the time honoured theory that the faradic current acts on the nerve and the galvanic on the muscle, and before it can be accepted we must consider the objections which have stood in the way of the general approval of this theory. It must be admitted that these objections are not very grave, and that the theory has failed to win acceptance rather from lack of definite proof than from any other reason.

In the first place we know that nerve tissue has, in general, a very much shorter chronaxie than muscle tissue. This has been proved for many different types of muscle and nerve by Keith Lucas and Lapicque. For instance, the muscle fibre of the frog's sartorius gives a chronaxie of ·007 sec. and the nerve fibres supplying the muscle give one of ·0005 sec. By selecting a region of the muscle where the intramuscular nerve fibres are relatively inexcitable it is possible to obtain double curves of the type shown in Figs. 4, 5 and 6, the rapid curve with strong currents being due to excitation of the nerve fibres and the slower curve to the muscle fibres.[2] The rapid curve disappears when the nerve endings are paralysed with curare and reappears when the effect of the curare has subsided. In this case there can be no doubt that the mechanisms in question are the nerve fibre and the muscle fibre. Moreover, the effect of curare shows that if the frog's nerve were damaged we should find the strength-duration curve passing through exactly the same series of changes as those observed in human muscle when the nerve degenerates. It is only reasonable to conclude that we have to deal with the same mechanisms in the case of human and of amphibian tissues.

In the case of the rapid curve we have a further proof that it represents the excitation of the nerve fibre from the fact that the same curve is obtained whether we use a cathode placed over the muscle itself or over the nerve trunk supplying it.[3] The only excitable structures in the nerve trunk are the nerve fibres, and therefore we may be certain that the rapid curve shows the conditions necessary for the stimulation of these nerve fibres, whether they are collected together in the nerve trunk or scattered through the substance of the muscle.

The slow curve has been assigned to the muscle fibre excited directly without the intervention of the nerve fibre. Against this view there is one objection which must be considered in detail. This is based on the experimental observation that a curarised muscle can be excited successfully by a

2 Lucas, *Journal of Physiol.*, XXXVI., p. 113, 1907.

3 Occasionally the chronaxie of the muscle at its motor point is actually shorter than that of the nerve trunk. The differences are small and not easily measured. If they are not due to experimental error, they are probably brought about by stimulation of the nerve-ending substance in the muscle by very rapid currents. The curve due to this substance can be detected in amphibian preparations, and it is more rapid than that of either nerve fibre or muscle fibre. However, I have not yet been able to obtain a triple curve in mammalian muscle corresponding to nerve-ending nerve and muscle, as may be done in the case of the frog.

faradic current. We have supposed that the muscle with degenerated nerve supply responds only to galvanism because the faradic current is too rapid to excite the muscle fibres. How then does it come about that the faradic current is able to excite the muscle fibres after the nerve supply has been cut off by curare? In the first place, it might be pointed out that the two cases are not strictly comparable, because a strong current is effective at much shorter durations than a weak, and it is possible to use a much stronger current in the case of an isolated preparation than in the case of an unexposed muscle stimulated through the skin. There is, indeed, some evidence that a faradic current, if it is sufficiently strong, may be able to produce a contraction in denervated mammalian muscles.[4] Again, the discharges from two coils of different pattern may have very different time constants, and there may be coils in use which give a discharge long enough to stimulate muscle tissue when the self-induction is increased by sliding in the core. However, the objection may be answered, without appeal to this evidence, from a consideration of the curves in Fig. 8. In this case the slow curve which we have assigned to the muscle fibre has a chronaxie of ·008 sec. when it first appears twelve days after the onset of the paralysis. The chronaxie becomes gradually longer and longer until the 28th day, when it has reached the value of ·032 sec. After this the rapid curve reappears and the chronaxie of the slow curve becomes stationary and then begins to diminish again as recovery progresses. Now it is clear that the value of ·032 sec. is not the chronaxie of the healthy muscle fibres, but of muscle fibres which have suffered by deprivation of their nerve supply. Even the original value of ·008 sec. may be considerably longer than that of the muscle fibre before the nerve was damaged, though it is probably not much longer, since the nerve fibres are still excitable on the 12th day, and it is unlikely that the muscle can have undergone much change at this date. It is clear, then, that we must reckon with the possibility of a slow progressive lengthening of the chronaxie for muscle after the nerve supply is cut off, and for this reason we cannot expect to find that a muscle with degenerated nerve supply will respond to the shortest currents which are capable of exciting a healthy muscle an hour or so after the nerve supply has been cut off by curare.

This appears to dispose of the only serious objection to the theory that the nerve fibre and the muscle fibre are the two mechanisms responsible for the rapid and the slow curve. Various alternative theories have been considered in a previous paper,[5] and for the present it must suffice to say that they have little experimental basis, and that they do not take into account the evidence given by amphibian muscle and nerve preparations.

Discussion of Results.—It remains to consider the bearing of these results on the practical question of diagnosis and prognosis. In the first place, if the muscle responds to currents of short duration, ·001 sec. or less, we may be certain that there are some excitable nerve fibres in functional connection with

4 Langley, *Lancet*, July 1st, 1916.
5 Adrian, "Brain," *loc. cit.*

the muscle. As may be seen from Fig. 8 these fibres will become less excitable if the nerve is degenerating and more excitable if it is regenerating. These changes can be made out easily enough from the strength-duration curve, and they might be inferred less certainly by the use of condenser discharges or even by the induction coil. Once the nerve fibres peripheral to the lesion have become completely inexcitable, we can only hope to determine the condition of the muscle, and electrical methods cease to give any indication of the condition of the nerve at the seat of injury. For this reason electrical testing must play an extremely subordinate part in deciding such questions as whether the cut end of a nerve is growing down towards the muscle or is blocked by scar tissue, whether an operation is advisable, etc. As Tinel points out,[6] there are several important and definite signs of regeneration which appear long before there is any change in the electrical reactions, and when the change does occur it can only confirm what was already known.

However, something may be gained from a knowledge of the chronaxie of the muscle after the nerve has degenerated. If it increases steadily, as in Fig. 8, it is clear that the muscle is deteriorating, and if regeneration is delayed there is a possibility that the muscle will be disorganised before the nerve succeeds in reaching it. In many cases the chronaxie remains stationary at a value of about ·01 sec. for long periods. This is particularly noticeable in peripheral nerve injuries due to gun-shot wounds. For instance, in five cases of complete division of the sciatic the chronaxie of the tibialis anticus was never greater than ·013 sec. even at an interval of nine months after the wound. The chronaxie reaches much longer values in the case of muscles which are prone to waste rapidly, *e.g.*, the small muscles of the hand in median and ulnar injuries, but on the whole the increase seems more liable to occur when the nerve injury is due to some toxic condition, as in poliomyelitis, polyneuritis, etc., and not to simple trauma. The most rapid increase I have found was that occurring in the case of facial paralysis recorded in Fig. 8.

This increase in the chronaxie of the muscle may give some grounds for a gloomy prognosis, and it might even be used as an argument in favour of operation if there was any reason to suppose that an operation would hasten the regeneration of the nerve; however, its most useful application would be in determining the value of the different forms of treatment which are used to maintain the muscle in as healthy a condition as possible pending regeneration of the nerve. For example, it is generally held that daily treatment with the galvanic current or some other form of electricity is essential to the well-being of the paralysed muscle; and yet the most recent and the most accurately controlled observations[7] suggest that such treatment has little or no effect at all. If it could be shown that electrical or any other form of treatment would diminish or abolish the slow progressive increase in the chronaxie of the muscle we should have a strong argument in favour of the treatment

6 *Loc. cit.*, p. 76.

7 Lovett, "The Treatment of Infantile Paralysis," p. 70, 1916. Langley and Kato, *Journal of Physiol.*, XLIX., p. 432, 1915.

under investigation. For the present we must be content to point out the possibility of research on these lines. As yet no results are available for analysis.

In conclusion, it may be as well to consider the statement made in the introduction of this paper to the effect that for prognosis or diagnosis little was to be gained by the use of elaborate methods. It has been shown that as long as the nerve fibres of the substance of the muscle are excitable at all we shall be able to produce a contraction by currents of very short duration. When these fibres are inexcitable, the current can only take effect on the muscle and long durations are necessary. The presence or absence of excitable nerve fibres can be detected well enough by the ordinary faradic coil, and except for purposes of research there is little to be gained by the use of condensers or any other more elaborate method. By these methods we might be able to detect changes in the relative excitability of the muscle and the nerve fibres, but it is doubtful if this can be done with any degree of certainty without determining the complete strength-duration curve. When the nerve has degenerated the faradic current becomes ineffective, since it is too rapid to excite the muscle fibres. As soon as this state of affairs is reached electrical methods cease to give any indication of the condition of the nerve at the seat of injury. Consequently, a simple test with the faradic current gives us all the information we are likely to obtain about the fate of the nerve, and this is the all-important factor in deciding treatment and prognosis. The use of the ordinary induction coil has been very strongly condemned on account of the impossibility of standardising the exact time relations of the discharge.[8] For purposes of research this objection is valid enough, but it has little force when we are concerned simply with a clinical test. In this case all we need to know is that the coil we are using will not give a discharge long enough to excite a muscle with degenerated nerve supply when the strength of current is kept within reasonable limits. As we have seen, there is a wide difference between the durations required for nerve fibre and for denervated muscle fibre, and therefore the time constants of the faradic coil may vary over a considerable range without affecting the essential condition that the current should be too rapid to excite the muscle fibres directly. For this reason a knowledge of the exact time relations of the discharge is a matter of theoretical rather than practical interest. The induction coil has also been criticised on account of the difficulty of standardising the rate at which the discharges are repeated. It is difficult to see the force of this objection. Apart from the fact that the contraction due to a number of discharges is more easily observed than that due to a single make or break shock, the muscle will respond to a single discharge as readily as it will respond to a series of discharges of the same strength and duration. The frequency of the discharges is scarcely ever rapid enough to bring about any summation of excitations,[9] and so long as this condition is observed the precise value of the frequency will be quite immaterial.

8 Hernaman-Johnson, *Lancet*, Feb. 19th, 1916.

9 Lucas, *Journal of Physiol.*, XXXIX., p. 461, 1910. Adrian and Lucas, *ibid*, XLIV, p. 68, 1912.

If we leave the fate of the nerve and consider that of the paralysed muscle it is true that faradic and galvanic currents do not give all the information it is possible to obtain. The galvanic current will show whether the muscle is still capable of any response to stimulation, but unless its duration is controlled it will not show how rapidly the muscle is degenerating. The precise value of this information has been discussed already. It is in this connection that the use of condensers may be an advantage. However, their application is not as simple as might appear at first sight. Indeed, there is very little to be gained from the statement that in one week the muscle will respond to a condenser of 1 mf. capacity charged to 100 volts, and that in the next week it will only respond to a capacity of 1·5 mf. at the same potential difference. Such a change might have been due to a lengthening of the chronaxie of the muscle, but it might also have been due to a diminution in the excitability brought about by an increased skin resistance or any other cause. Since the least effective duration of the discharge depends on the strength of the current relative to the rheobase (cf. Fig. 1), it is absolutely essential to know not only the least capacity of condenser to which the muscle will respond, but also the relation between the strength of the current employed and the strength required for a current of infinite duration. For practical purposes we should have to measure the threshold strength with a constant current lasting one second or more, and we could then use condensers charged to some definite multiple of this strength. If this precaution were not taken the results of successive examinations would not be comparable, because we should have no means of eliminating the effect of variations in the excitability of the muscle. The only other way to avoid this source of error would be to use very strong discharges in every case. As the current strength tends to infinity the curve becomes very nearly vertical, and therefore when very strong currents are used variations in the rheobase are of little importance. This method involves several practical difficulties, of which not the least is the danger of current spread to neighbouring healthy muscles. Even with these precautions there are several pitfalls in the way, as Bourguignon has shown,[1] but it is nevertheless true that a method based on the use of condensers of different capacities should allow us to determine the progress of the muscle after the nerve supply is cut off, and might give information of great value as to the effects of treatment, though it is open to question whether it would not be simpler in the end to use the method of constant currents described on pages 382-3. For the purpose of deciding whether the nerve has degenerated or not it is difficult to see that the condenser has any advantage over the simple faradic coil. Whether the nerve is growing towards the muscle or is prevented from regenerating by scar tissue is a problem which must be dealt with by neurological or surgical tests ; the most elaborate electrical tests are quite incapable of deciding it.

It remains only to consider the electrical phenomena found in cases of incomplete nerve injury, contusion, compression, and the like. As a rule these

1 "Comptes Rendus," 162, p. 262, 1916.

cases are readily distinguished by sensory tests and other neurological evidence. The strength-duration curve may be of the simple rapid type corresponding to the excitation of nerve fibres, or else of the double type indicating a diminished excitability of the nerve relative to the muscle. In a few cases the nerve is much less excitable below the seat of injury than above it, and when this occurs the response to short currents is more readily obtained by stimulating above the level of the injury.

Theoretically it should be possible to measure changes in the conductivity of the nerve fibres not great enough to abolish conduction altogether. Such changes would not necessarily be accompanied by any alteration in excitability except in the immediate neighbourhood of the injury. In isolated muscle and nerve preparations a very small change of conductivity can be detected readily enough by measurements of the least interval for muscular summation, with two stimuli separated by a short time interval. The reasoning on which this procedure is based may be found elsewhere,[2] and for the present it must suffice to point out that there are considerable practical difficulties in the way of such measurements in the human subject. A possible method of overcoming these difficulties is foreshadowed in Otto May's results with the Leduc commutator.[3] However, a method of this kind would involve a very searching analysis before any tangible results could be obtained.

For permission to publish these results I wish to thank the medical and surgical staff of the National Hospital for the Paralysed and Epileptic, Queen Square, and Lieut.-Col. Turner, officer in charge of the Connaught Hospital, Aldershot.

2 **Lucas**, *Journal of Physiol.*, XLVI., p. 470, 1913. **Adrian**, *ibid.*, XLV., p. 403, 1912.
3 "Brain," XXXIV., p. 272, 1911.

THE USE OF X RAYS IN THE GREAT WAR, WITH A NEW METHOD FOR LOCATION OF FOREIGN BODIES.

By Major A. Gale Straw, A.M., M.D., Roentgenologist, Manchester, N.H.

Paradoxical as it may seem, there is not always a foreign body present in the body of a patient who has an apparent wound of entrance and no wound of exit, and in these cases, which are indeed quite numerous, the employment of the X-ray is of inestimable value, since it quickly disposes of the patient, and avoids a long search with the probe, forceps and knife which otherwise must have been used, besides wasting most valuable time which could have been devoted to soldiers urgently needing attention and relief from the surgeon. Again, in cases of suspected fracture, the soldier is sent to the X-ray Department, where it is ascertained by screen or plate whether or not there *is* a fracture, and if so, to determine, by plates taken at right angles to each other, the position of the fragments. The fracture is then reduced as

perfectly as possible, and is then returned to the roentgenologist for inspection of the work, and if found imperfect it is returned to the orthopædist for correction, until the fragments may be so accurately adjusted that the resultant united bones may leave the limb as mechanically perfect as ever.

Of course, the work of the roentgenologist employed in army hospitals covers a wide range, embracing mastoids, heart, lungs, stomach and dental work, but the great preponderance constitutes the location of foreign bodies and the repair of fractures.

Now during normal times of peace the surgeon is but infrequently called upon to remove foreign bodies of this character, and hence, this special technique of accurate localization was crude and undeveloped, not to say unsatisfactory; so when the war broke out the roentgenologist was brought face to face with the necessity of devising some better system of accomplishing his results, for he must needs unerringly guide the surgeon's knife and forceps to the unseen goal, and in a way clear and uninvolved and without undue loss of time.

As was to be expected, there followed a perfect avalanche of new methods of various degrees of merit and efficiency, but most of them were so intricate and involved as to render them unwieldy for the purpose of the surgeon. By degrees, the system became less and less complicated until now we have at hand a method both reliable and simple, as put forth in the McKenzie-Davidson system, which is undoubtedly the one most widely in use, and the basis from which most other systems arise.

There are, however, some few objections which might be brought against this system, such as the use of blackened cross wires, which leave a mark upon the skin of the patient, and from which a definite point must be found by measurement, and since the marks are often indistinct, and oftener entirely obliterated during the pre-operative scrubbing, the surgeon is oftentimes lost at this last moment and cannot avail himself of the X-ray findings.

Then it requires some little time to develop the plates and work out your distances, which you are to measure from the marks of the cross wires on the patient.

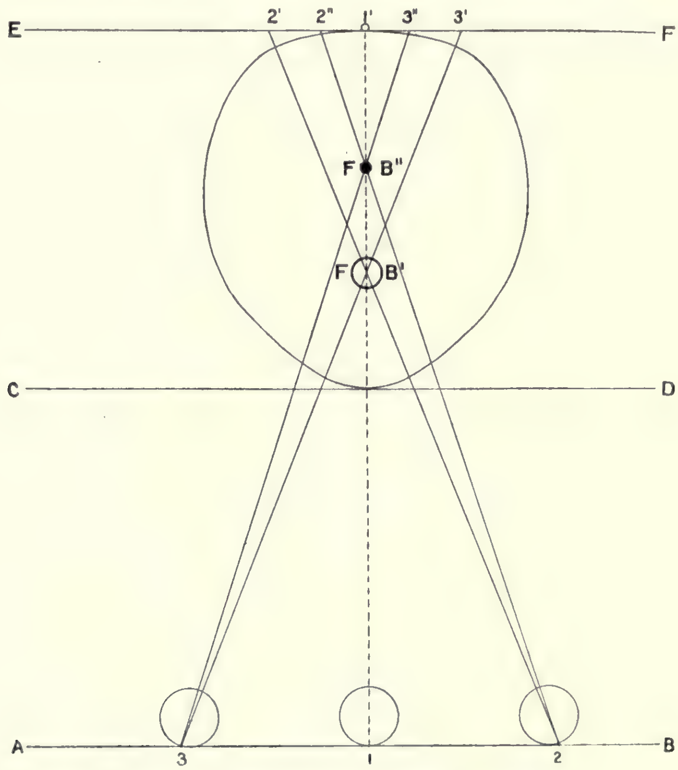
However, the system is an accurate one, and yields very satisfactory results, but is trammelled with vexatious difficulties.

During a service extending over a period of nine months in the hospitals "somewhere in France," in the British Expeditionary Force, I used several systems successfully, but, as I have intimated, I was not perfectly satisfied with any of them, they were too cumbersome, until at last I was able to evolve a new technique and put it in practice, which yielded most satisfactory results during the greater part of my service and is still in use since my departure. It has the superiority over other systems in that it is rapid and accurate, and is done by the use of the fluorescent screen, and the entire process can be completed in much less time than it would take to describe it.

The technique requires a darkened room, an X-ray table with the tube operating underneath, and a means of shift of the tube from one point to another. With the patient reclining upon the table, and a fluorescent screen

above him, move the excited tube into such a position as will cause the shadow of the foreign body to fall upon the screen, then diminish the opening of the diaphragm to the smallest workable size, in order to cut out the divergent rays, and allow only the vertical rays to be projected upon the screen; next centre the tube beneath the foreign body, and it is evident that the shadow on the screen is directly over the foreign body.

Having a metallic ring mounted on a wooden handle  pass this ring beneath the screen and place it upon the skin of the patient in such a position that the shadow of the foreign body appears on the screen encircled by the ring, remove the screen and mark on the skin, with Tr. Iodine, Sol. Ag.



In the figure let A B represent the plane of the tube.
C D ,, ,, top of X-ray table.
E F ,, ,, fluorescent screen.
F B′ ,, ,, foreign body to be located.
F B″ ,, ,, metallic ball on wooden handle.

No. 3, India ink or otherwise, the location of the foreign body inside the ring, which is still held in position on the skin of the patient.

This mark indicates the location of the foreign body, and it is evident that with the patient *in the same position* (an important and necessary point to be remembered with this system) a *vertical* line passing through this mark must encounter the foreign body at *some* depth, which we can easily determine.

If the foreign body is in a portion of the body which can be rotated, so that the shadow can cast upon the screen from a point at right angles to the point marked on the skin, proceed as described above, and the distance between two

parallel planes passing through the two marks on the skin will indicate the depth of the foreign body.

If, however, the foreign body is in such a position that a shadow cannot be obtained from the two angles another method must be followed.

It is evident that with the tube in position I, the shadow of FB′ will appear on the screen at I′. If the tube be shifted to position 2, the shadow will appear at 2′. If again shifted to position 3, the shadow will appear at 3′, and if vibrated between positions 2 and 3 the shadow will travel back and forth between 2′ and 3′.

If a ball mounted on a wooden handle  be introduced under the screen, and placed on the body of the patient in line with the foreign body to be located (FB′) but nearer the screen, the shadow of FB″ will make a shorter excursion with the vibration of the tube from 2 to 3, than does that of the deeper body ; gradually move the mounted metallic ball on the body away from the screen, and again vibrate the tube, and when the excursions of the shadows FB′ and FB″ on the screen are of equal length you have reached the depth of the foreign body in question.

Mark the position that the ball occupies on the skin, take the distance between two parallel planes passing through the two marks, as before, and you have the depth of the foreign body.

In operating for the removal of such foreign bodies, always remember that the markings on the skin are *only* reliable when the patient is in the same position as when the marks were defined.

Although the explanation given above may seem involved, yet in practice the method will be found to be both rapid and accurate, a system indispensable in military radiography.

A CASE OF PIN SWALLOWING.

By Harold Black, M.D., M.R.C.P. Birmingham.

At the present time when so much of the work of X-ray departments has to do with the detection of foreign bodies, it is interesting to find a case presenting unusual features.

The patient was a woman of 32 years, who had been under care in an asylum, but who was discharged as cured some years ago.

Of her own accord she consulted a doctor, complaining of abdominal pain after food. She said that for the past year she had been in the habit of swallowing pins, hairpins, and hatpins, with the idea of suicide. Her statements were so absurd that she was sent to me to confirm or disprove them.

Screen examination of the thorax revealed two hairpins that had been straightened out, lying in the œsophagus. In the abdomen the assorted collection that is seen on the illustration was found.

The case is one that might well be borne in mind when we are called upon to calm parents who are anxious for their child because it has swallowed a foreign body.

REPORT OF SOCIETY.

RÖNTGEN SOCIETY.

Captain C. Thurstan Holland, M.R.C.S., Nov., 1916.

Presidential Address.

In the first place, I should like to thank you for the great honour you have done me in electing me as your President for the second time. It is an honour which I can assure you all I deeply appreciate, and I shall endeavour to carry out the duties of the position in accordance with the great traditions of the Röntgen Society.

I assume that it will be in accordance with your wishes that I should take this opportunity of expressing the loss that the Society —the members individually, and the cause of science generally—have sustained by the untimely death of our first President, one of the founders of this Society, Professor Sylvanus Thompson.

I remember him as the first Professor of Physics at the then recently established Bristol University College. As a school boy of sixteen years of age I was amongst the first students there. He was then, in his early days, a man who both lectured and taught well, who took endless trouble and pains to instil into us even the very elementary physics required for the London Matriculation examination; and his kindly manner, added to the fact that, in the true sense of the term, he was a teacher, made him popular with all his students. Years later I met him again at the soiree of this Society, held in St. Martin's Town Hall on the evening of Friday, November 5th, 1897. Many of you may remember his brilliant Presidential address, delivered to a large, representative and appreciative audience, a good send off to a society which now for some twenty years has proved its value. It is twenty years since I took my first radiograph, twenty years brimful of interest, and of advances which, in those days, none of us could have even dreamed about, advances which may perhaps be illustrated by the fact that the first successful radiograph I saw taken was that of a hand, and the exposure was 1¾ hours. Almost the last one I took myself was one showing a bullet with its point sticking into the posterior surface of the heart in the mid-line of the body. A direct lateral view was made so rapidly that the shadow of the bullet (which was never still even for a fraction of a second) is quite sharp.

A Presidential Address is a serious matter, but whether it is a more serious matter for the President than for the members who have to listen to it is a moot point. At any rate the President has certain advantages—he can inflict what he likes upon his audience, and take as much time as he pleases.

In thinking over various questions which might form the basis of an address I finally decided that one might suitably make some remarks on the status of Radiology and Electrotherapeutics, the status of those who practise these branches of Medicine, and on what naturally follows, the teaching of these subjects.

What has perhaps influenced me more than anything else in the choice of subject is the effect that this war has had on radiography and those practising it. What I mean by this is possibly best illustrated by two or three examples.

1. We have the fact that at the beginning of the war the X-ray department of a large military hospital was put in charge of an unqualified (that is, of course, a gentleman with no medical qualifications—and please understand that in the course of my remarks if I use the term "unqualified" it always means one having no medical qualification), having an officer's commission, and he had working under him a duly qualified medical man well up in X-ray work. However eminent in his own line, and he is an eminent physicist, that he should be the chief of a department directing a qualified man in his work, is preposterous. Such an arrangement should be an impossibility.

2. Two assistants in a physics laboratory

were sent to the military hospital to which I am attached with orders for facilities to be given them to learn X-ray work. Their knowedge of medicine was, of course, nil. They came to my department for a few hours a day for a week. Shortly afterwards I had letters from them thanking me for the instruction, and informing me that they had been given charge of X-ray departments in large hospitals. Comment is unnecessary.

3. An elderly medical man came to me, from a hospital ship being fitted up in Liverpool, asking for instruction in X-ray work, as he was to have charge of this work on the ship Practically he knew nothing about X-ray work, so I enquired the reason of his appointment. The reply was "Oh, the C.O. called the officers together, allotted them their duties and informed me that I must do the X-ray work."

Incidentally I may add that the ship was equipped two days before she sailed by a well-known London X-ray firm; I was telephoned for to go and see the apparatus. It was beautiful, it must have cost a very large sum of money, it was most elaborate, and I can honestly say that I did not know what some of it was for or how to use it. Amongst other things was a large quantity of 15 by 12 X-ray plates—you know what they cost—and I am perfectly certain that not one of them was ever used. If any qualified expert had had the fitting up of this ship the country would have been saved a considerable amount of money, and, this is of more importance, would have had a practical set of apparatus on board.

Similar occurrences to those I have related could no doubt be multiplied over and over again. The results of such practices may be summed up and illustrated by quotations from papers, and by the recording of what is common knowledge.

As bearing on this one should remember that from the X-ray point of view there are two classes of medical men unacquainted with X-ray work:—

1. Men who recognise to the full the value of radiography as carried out by, and interpreted by, those who have made themselves into specialists on the subject, and, knowing nothing about radiography, rely upon the expert's opinion.
2. Others who believe they intuitively know all there is to know about radiography, and who believe that no trained skill or experience is necessary to read a radiograph for diagnostic purposes.

Now recognising these two classes of medical men unacquainted with radiography, one result of bad radiography (*i.e.*, unskilled or unqualified radiography) on the latter class is mistakes of interpretation, mistakes in localization, belittling the value of radiography, and rash utterances in various publications. For example, in a discussion on X-ray work in France in the early part of the war one surgeon is reported as having said "that he did not consider any existing method of X-ray localization as of really any great value to surgeons." Another surgeon has definitely published the following:—"If *after* operating I failed to find the foreign body I then availed myself of the help of X-ray plates." A third observation I came across is as follows:—"A skiagram, after a bismuth meal, was taken and the position of the stomach was seen to be midway between the umbilicus and the pubis."

The two former are excellent examples of the state of mind brought about either by unskilled radiography, by radiography carried out by non-medical men, or by surgeons without knowledge interpreting their X rays for themselves.

The third, describing the stomach as being situated between the umbilicus and the pubis is, of course, pure unmeaning balderdash.

In addition many of us know that as a result of X-ray work being carried out by unskilled and untrained operators, there have been a number of burns inflicted upon wounded soldiers, either in the course of X-ray examinations or in the course of removing foreign bodies under the screen; and also that some of the operators have themselves been burnt—a return to the conditions of the early days of X-ray work; but then we knew not the risks and how to guard against them; now the cause of danger and the conditions of safety are well known.

Further, as showing the risks to patients when there is the combination of a rash surgeon and an unqualified radiologist, a striking example came directly under my own obser-

vation, and is merely one of many similar, but not so sensational, cases I have seen. The case I allude to was a wounded soldier brought home on a hospital ship from the East. His anterior chest wall over the region of the heart bore the mark of a large operation wound—the incision a good 4 inches in length—the bullet, for the removal of which the operation had been planned, as a matter of fact was about 1½ to 2 inches deep in the muscles of the back. An X-ray apparatus had been installed upon the ship, but unfortunately no one was competent to use it.

To multiply these examples is needless, those I have quoted fully illustrate the main point at which I am aiming, namely, to emphasize the bad effect on everybody interested which untaught and unskilled work must inevitably bring about, and further to emphasize the point of the danger that one result of this war may be that a very large number of non-medical men and women will attain a certain amount of knowledge of radiography, and a large number of medical men will be imbued with the idea that no training is required either to take successful radiographs or, and this is of even greater importance, to interpret them.

In the early days of this Society, which means in the early days of X rays, much valuable work was done by non-medical men. I do not allude to research work and such like, but much actual radiography was done, often by instrument makers and chemists, but also by a few whose technical knowledge of physics and electricity helped them in the management of the apparatus. What I mean is that the X-ray examination of medical and surgical cases was undertaken by such workers. Now, without wishing in any way to under-estimate the work which was thus accomplished, I maintain that the time for that sort of thing has gone by. In those early days there were few medical men with the technical knowledge necessary for successful X-ray work. In those days the chief desideratum for some time was a good plate; this, although of great importance at the present time, is nevertheless nothing when compared with the real essential for an X-ray expert, namely, interpretation. The former, the good plate, can now be obtained by anybody with modern apparatus with very little training; the latter, interpretation, can only be done by a medical man of unusual professional attainments, who has given years of close study to a very difficult subject.

Whilst on this point of the non-medical X-ray practice for gain I should like for a moment to digress to call attention to what, in my opinion, is a very deplorable fact, namely, that there is a distinct tendency amongst certain surgeons and physicians to send their X-ray work to unqualified people. This is more especially the case in London, and to my certain knowledge it is done by eminent members of the medical profession.

At the present time when nearly every large hospital in London has attached to its staff a medical expert, and when practically all these men are trying to earn their living at X-ray work, it seems to me to be a very anomalous state of affairs, to say the least of it, that physicians and surgeons on the staff of such a hospital should not hesitate to use the hospital X-ray department and expert for their hospital work, but should send their private work to a non-qualified man.

The reason for this is most certainly not because the work is better done, although this is, I understand, one of the reasons which has been used as an excuse. I believe the true reason to be that certain gentlemen do not desire expert X-ray opinions, but wish to give their own interpretations of the radiographs to their patients, and thus avoid any possibility of any friction of opinion which might or might not be of benefit to the patient. This support of non-qualified medical work is not, in my opinion, in the best interests of the profession.

To resume. I said that X-ray interpretation required a man of unusual professional attainments; I should qualify this to a certain extent by saying that the real X-ray expert must necessarily be a man of unusual professional attainments. Why do I say this? The answer to it is seen by what goes on every day in the well equipped radiographic department of a large hospital. The man in charge must have a thorough knowledge of physics, chemistry and electricity. He must be to a certain extent an electrical engineer. He must be a very expert photographer, he must

be a good organizer, he must have more tact than most people if he is to run the department without constant friction with other members of the hospital staff—perhaps I might venture to go as far as to say that tact is one of the most important of all the qualifications, but all this is really nothing when it comes to the medical qualifications which are requisite. Consider the cases which are treated by X rays. They range from ringworm and a large number of skin diseases to glandular affections of various kinds, many systemic diseases, and last, but not least, the various forms of malignant disease. An intimate knowledge of all these is absolutely necessary if the treatment is to be carried on in a scientific manner. That is, our expert must be able to discuss skin cases with a skin specialist and medical cases with a physician. He must know his anatomy very thoroughly indeed if he is to answer all the questions which will crop up in his surgical work, the anatomy of bones at all ages, the general anatomy of the entire body—this latter point having been accentuated of late by the necessity for the accurate localization of so many foreign bodies. He will not be able to put the proper interpretation on many plates if he is not well up in the pathology of practically all diseases, inasmuch as he has to know the conditions which are caused by various diseases and fit these in with what is found to be X-ray abnormal. It is obviously of no use to show an abnormality of, say, a chest unless an accurate knowledge of the various diseases which could—and also could not—give rise to such an X-ray abnormality is possessed.

I do not wish to labour this point, but I think it is clear that the radiologist must be well up in surgical and medical diseases, and possess more than a little knowledge of most special diseases. The practice of X rays covers such a large field at the present time that fractures, bones and their diseases, the location of foreign bodies and so on form but a small part of X-ray work. When we come to sinus work, to the examination of the thorax and its contents, to the differential diagnosis of kidney stones and other shadows, to say nothing of numerous other things, it must be obvious to all that the expert radiologist, to be successful, must be, as I have already said, a man of unusual professional attainments. In the picture I have drawn up before you, you will see that in a hospital X-ray department it is becoming more and more of a necessity that the X-ray expert—who always has his medical and surgical colleagues to consult with—should have to assist him trained assistants to carry out the more or less routine part of the work. There is, and can be no objection to these assistants, male or female, being taught to take plates, to administer doses of X rays, to carry on routine work, but, and this to my mind is of paramount importance, no opinion should be given by such assistants, no treatment carried out on their initiative, and that the head of the department should hold all the strings very firmly. Further, if this is essential in a hospital department, how much more essential should it be in outside work, that no one should be allowed to practise this speciality for gain, unless he or she is duly in possession of a medical qualification. In hospital work it is always possible to get valuable help from colleagues on the staff, in private work one must rely upon oneself entirely.

Let us for a moment consider what the present condition of radiology is in this country. I will begin by pointing out that, undoubtedly, the X-ray department is the most important single department in any hospital. In a general hospital in which the department has been allowed to reach its full development, and in which the man in charge has been well supported by the rest of the staff, it is not too much to say that the cessation of its work would paralyse the work of the whole hospital. The out-patient diagnosis of fractures—as carried out by senior students—would cease to be an exact science. The surgery of kidney stone would no longer exist. The certain diagnosis of a large number of conditions affecting the thorax—for instance, the early diagnosis of aneurism—would not be possible. The exact diagnosis of stomach conditions—inasmuch as an X-ray examination is essential for the knowledge of many facts in connection with this organ—would return to the condition of pre-X-ray days when a diagnosis of atonic dyspepsia covered a multitude of sins. These are merely examples of what would happen.

Recognise these facts. What is the present position of most men in charge of X-ray departments? What are considered to be the qualifications in a large number of cases which the man who is put in charge should possess? Often—too often—the post has been given to anyone who would take it. Often—and again too often—it has been given to a man who has not been considered quite good enough (in the opinion of the authorities) for other hospital posts. It says much for these men generally that many of them have risen to become recognised authorities in their work, many have become well known in the world of medicine, often far better known than others considered more worthy of so-called senior posts.

Another point. Taking the large teaching hospitals of this country, how many of those in charge of X-ray departments are full members of the staff with the privileges of such a position. Singularly few. Many have no position whatever as members of a hospital staff; many are paid small honorariums—not from feelings of generosity—but so as to ensure their being kept in a very junior position. Unfortunately this is largely due to the attitude of physicians and surgeons holding full staff appointments. I know of one large provincial hospital in which the brilliant chief of the X-ray department—a man whose name is well known for original work all over the world—is paid a small honorarium. His lay committee—lay, mark you—recently suggested that he should be promoted to full staff appointment. A physician as representing the medical board, a man whose name is not, and will never be, known outside his own town, and is not perhaps particularly well known even there, opposed this tooth and nail. I cannot say how much of his opposition was as representing the medical board, or how much merely personal, but I understand that he had the impertinence—for it was an impertinence—to suggest that instead of making the head of the department a full member of the staff, it would be better that one of the honorary physicians or surgeons, already a full member, should be made the titular head of the X-ray department.

As a contrast to this it may be of interest to quote from the celebrated surgeon, Willy Meyer, of New York (*Medical Record*, Dec., 1915, p. 1079). Writing of radiologists he says, "In general we rarely meet a class of colleagues who are, as a rule, more careful and reticent in rendering a definite conclusion on the basis of their examination."

Peter Harding, in that altogether delightful book, "The Corner of Harley Street," said of a bacteriologist or pathologist—it was before the days of X rays or I am sure he would have included the radiologist—"For though as a profession, we must needs lean each year more heavily upon the skilled workers at our right hand, yet at present we are all very reluctant to give them their full dues either in professional *éclat*, or in pounds, shillings or pence. All the same their day is coming." But if, ladies and gentlemen, we are not appreciated as we should be by the profession, this, at any rate, is not the case as regards the general public.

Let me tell you a little anecdote against myself. I had been examining a wounded soldier with the screen for a possible foreign body. One was present, and it was duly localized, the whole operation being a screen one. The lights were turned up, and I proceeded to my desk to write the report. The Sister came up, and I noticed that she was smiling in a curious manner. The answer to my request for information was as follows:—"Oh, the Tommy asked me who you were, Sir, and when I told him, he said, 'Eh, Sister, he must be a very clever man, if he could see all that in the dark; what would he have seen if the light had been up.'"

To resume. If it is true, and I believe it is, that the large teaching hospitals of this country do not take a sufficiently serious view of the importance of the position and education of the head of an X-ray department, what can be expected from the more numerous, but equally important—from the patients' point of view—smaller hospitals which exist in almost every town in the kingdom. At the present time large numbers of these are equipped with X-ray installations, many very inefficient, some very good. Almost without exception, I may truthfully assert, that those who do the X-ray work in these hospitals are either medical men without special training or knowledge, or else nurses, dispensers

and other people who have not had proper training, even in the technique of working the apparatus.

How, as a rule, are these hospitals equipped? By experts? No, the usual routine is that some rich person finds a sum of money for the apparatus: certain members of the professional staff and the lay committee consult various instrument makers; finally they become enamoured with the apparatus of a certain firm, this firm draws up a specification of what is required, this is accepted and the apparatus is installed. Then, and probably only then, does it occur to those interested that someone must be found to undertake the work. Perhaps a medical member of the staff volunteers, just as often the dispenser, a nurse or some other unqualified individual starts on the work.

The faults of, and the remedies for, such a system are obvious. In the first place, each individual firm of instrument makers is interested in supplying its own special line of goods, and of course does so. If an expert in radiology were equipping a department he would draw the best from various makers and so assemble an efficient whole.

The remedies for the second condition—that is, the inefficient working of the department—I shall deal with later on, but before doing this, allow me, by means of illustration, to point out the dangers of the present position of affairs.

Jealousy between hospitals, and the staff of hospitals is such, that even in a large city like Liverpool, in which the Royal Infirmary is well equipped with apparatus, has a complete and very efficient lay staff, and myself and my partner, Dr. Oram, control everything which goes through the department, and in which other large hospitals are similarly situated, no smaller hospital or institution would for a moment think, if it possessed an X-ray outfit—efficient or otherwise—that it should not undertake the responsibility of certain X-ray cases, but should refer them to be properly dealt with. No, rather than that this should be done, if a patient comes to such a smaller hospital, the X-ray examination must be made and acted upon, however inefficiently it is carried out. What is the result of this? Tragedies! I have myself seen a case of a child a few months old who swallowed an open safety pin. The X-ray examination was made at a certain hospital and a plate taken by a medical man who had never been taught anything about radiography. On the strength of this examination, the stomach was opened to remove the pin which was not there, it was in the œsophagus at the level of the root of the neck. Later on I saw the plate, on the evidence of which the stomach was opened; there was not the slightest shadow suggesting the presence of the pin, and that which was pointed out to me as the possible shadow was a perfectly obvious plate flaw. The child died.

I saw only the other day a boy who was supposed to have swallowed a coin sixteen days previously. He was ill—very ill—with obvious clinical symptoms, yet the father assured me that he had been to a local hospital, the boy had been X-rayed there, and he had been told positively—as a result of the X-ray examination—that no coin was present. The coin, however, was in the œsophagus at the level of the bifurcation of the trachea; it was removed and the boy recovered—it might well have been another tragedy.

Now if instances of this kind can happen in the easiest of all possible cases, what must be going on in such hospitals in all the other numerous conditions dependant upon successful radiography, conditions not so obvious to the lay public?

I do not hesitate to say, from my own personal knowledge of what is going on, that, far from being a boon to patients generally, many hospital X-ray installations, worked as they are, by either untrained medical men or by equally untrained non-medical persons, it does not matter very much which, are a standing danger to the community, and that the good they do, and the information they yield in a certain number of cases, is far more than counterbalanced by the mistakes made, and by the reliance placed on X-ray examinations and the opinions deduced from them which are hopelessly wrong.

What is the use of being able to take a plate of an obvious fracture, I mean obvious without any X-ray examination, in which the treatment and results may, or may not, be

improved by the possession of such X-ray knowledge, when on the other side of the page is a missed kidney stone and a patient suffering unrelieved for years as a consequence; or an error in diagnosis as to the position of a swallowed pin and a consequent death? No, the time has come to enter a strong protest against the continuance of methods which allow of such anomalies to exist.

In no other department of medicine and surgery would such a condition of affairs at a hospital be tolerated for a moment. The pathological or bacteriological work is referred to men trained especially to carry it out. It is not considered that the mere making of microscopical slides, or of cultivations, is all that is necessary—both can be done by laboratory assistants—but the chief of the department must be in a position to give a qualified expert medical opinion as to the bearing of the work he controls. An oculist to a hospital is specially trained, the same applies to the skin, throat, or ear specialist.

All the pioneers of these special branches of work had to fight not only for their own positions but also for the positions of the individual specialists, and these had to be won in spite of strenuous opposition from, and tardy recognition from, the pre-existing members of hospital staffs. X-ray men will have to make the same fight for radiology, but they may do it with the certain knowledge that in the end victory must come, and this speciality will also have the position which is its due, the teaching which is its necessity.

(I should like to say, at this point, that my own experience at the hospital to which I am attached is altogether different, and if every chief of an X-ray department had the same consideration, and the same loyal support, from his professional colleagues, and from his lay committee, as I have had, there would be nothing to adversely criticise.)

(To be continued.)

REVIEW OF JOURNAL.

Medical Record, October 21st, 1916.—"The Management of Poliomyelitis with a View to Minimizing the Ultimate Disability." Meeting of New York Academy of Medicine.

Dr. W. Lovett, in his paper on the treatment of poliomyelitis, said that while orthopædic surgeons have prescribed braces, with perhaps massage or electricity or muscle training as of probable use, the neurologists have been less enthusiastic about braces and have, on the whole, favoured electricity, about the value of which there has been much controversy. The general practitioner has ordered braces from the instrument maker (who fitted them himself) and has thought that electricity and massage were of use. All have felt that the condition is an undesirable and tiresome one to have to treat. The speaker divided the course of the disease into three stages from the point of view of treatment. Onset, where no electrical or other active physical treatment is correct; convalescence, and the chronic stage. The same arguments as to treatment belong to each of these latter. He considered his method of muscle training to be the most effective means of curing the paralytic conditions and described them at length. With regard to electricity he wished to avoid controversy and to make a fair statement of present opinion, leaving definite assertion until he could support it by facts and figures produced by his own method of research now proceeding.

Faradic electricity produced a mild form of exercise, and was probably mildly effective, though disagreeable. Galvanic electricity, and the newer forms, such as high frequency, sinusoidal, static, etc., were supposed to act, in a way less understood, in improving muscular power and nerve conductivity. In his own experience, where he had used a form of electricity on one side of bilateral cases, he had not found faster gain on that side. The objection to electrical treatment was that it had

been extensively used, mostly in a wrong and loose way, and meanwhile parents had neglected other methods. The possible efficiency of electricity, in combination with other methods, could only be settled by a sufficient number of quantitative examinations. Meanwhile he claimed that it should not constitute the sole treatment, and that it was probably of no value when used by laymen.

Dr. SIMON FLEXNER described the pathological processes on which basis the rational treatment should be determined.

Dr. FREDERICK TILNEY said that it was important to localize the lesion early, and to this end the electrical reactions should be studied from the outset of the disease. The disappearance of tenderness was the best guide to the time to begin active treatment, and might be from the fourth week onwards. Electrotherapy had fallen into disrepute because it had been wrongly applied, and had, therefore, produced poor results. He considered that the sinusoidal current was the most suitable, and that it should be used after a preliminary heating and massage of the limb. Suitable corrective apparatus, re-educative movements, and massage were also necessary measures, and every case was entitled to a combination of all these means of treatment for a long time before it could be said to have had a full opportunity of recovery.

Dr. FOSTER KENNEDY said that there could never be an even balance between the advantages of apparatus and electricity, because the former could be destructive and the latter at its worst could be no more harmful than an incantation! Rigid apparatus, placed on a muscle whose innervation was already damaged, made that muscle more atrophic and recovery more difficult. Passive movements and massage should be given five or six times a day for five to ten minutes. Given three times a week they were useless.

Dr. ABRAHAM JACOBI considered exceptional the case of a child who fully recovered after 600 to 800 applications of the galvanic current during a number of years.

Dr. HERMAN C. FRAUENTHAL preferred the galvanic current as a means of electrical application, but said that all currents had a value in the hands of the man who understood their effects.

N. B.

NOTES AND ABSTRACTS.

ELECTRO-DIAGNOSIS.

Paralyses from Changes in the Nerve with Incomplete R.D. J. CLUZET (*Jour. de Radiol. et d'Elect*, Nov. 1916, p. 381).—For the examination of nerves and muscles, and especially as to the presence of R.D., the condenser method is quicker and simpler than the more usual method, is carried out by a very portable apparatus, and does not necessitate any important changes in the recording of electro-diagnostics.

When using this method, one cannot confuse, as may be done with the other method, the galvanotonic contraction with the slowness of contraction. It is probable that such confusion has taken place in certain cases of nerve paralyses, and in cases of primary myopathies which have been said to show complete R.D.

Slowness of contraction has been regarded as a constant sign of alteration of the nerve. The authors quote five cases of paralyses with nerve changes (confirmed by operation in three cases) not accompanied by sluggish contraction, and therefore showing incomplete R.D. Therefore, escape of the nerve should not be assumed although the muscular contraction is brisk. There can exist an alteration in the nerve which shows incomplete R.D. due to the inexcitability of the nerve trunk and of the muscle to impulses of short duration.

Incomplete R.D. may be due to an incomplete degeneration of the muscle characterised by an increase of the interstitial tissue and a diminution of the number of muscular fibres, the fibres which remain not having lost their striation, as seen in cases of R.D. with sluggish contraction.

The prognosis is, of course, more favourable when muscular contraction remains brisk.

R. W. A. S.

ELECTROTHERAPY.

Disappearance of Verrucæ Vulgares and Planæ, after Treatment of the Wart which appeared first. J. Gouin (*Jour. de Radiol. et d'Elect*, Nov. 1916, p. 374).—For verrucæ vulgares, the author uses either radiotherapy or electrolysis. X-ray treatment is quite pleasant, but a delicate procedure, a dose of 7-10 H units is stated to be the best, and the greater the size and age of the wart the greater the dosage necessary. The mother wart and her satellites (not necessarily treated) fall off between the twentieth and the sixtieth day. Electrolysis, the author says, acts perhaps more promptly though more painful, and in this case the treated wart disappears the first, followed by the others. The current used reaches to 4-6 ma. for the largest and oldest.

For verrucæ planæ, the author almost invariably uses radiotherapy, giving a dose of 3-3½ H. units. In three weeks to a month the irradiated warts, along with the others, disappear entirely.

By these methods both varieties of warts disappear, leaving no cicatrix. Finally, it is pointed out that it is sufficient, in nearly all the cases, if not in all, to destroy the warts which appeared first to ensure the disappearance of the others without actually treating them.

R. W. A. S.

Excitability and Conductivity in War Injuries of the Nerves.—Battez and Desplats (*Arch. d'Electr. Méd.*, June, 1916, p. 170).—These authors divide injuries of the nerves into two classes.

1. Where the response of the nerve to the faradic current remains.

2. When the response of the nerve to the same current has disappeared.

Reviewing the injuries in the first group, they find that in no case which was subjected to operation was the nerve found to be divided; in almost all the cases compression of the injured nerve by a fibrous band was found, while in some no apparent lesion was discovered; and in all the same response persisted after surgical interference.

As to the injuries in the second group, the great majority showed a division of the nerve but others a marked compression.

The following conclusions are formed by the writers:—

1. Response to faradism never exists in a divided nerve.

2. The presence of this response always indicates that there is continuity of the nerve.

3. This response often remains though all voluntary conductivity has disappeared.

4. The absence of this response does not necessarily imply a division of the nerve.

R. W. A. S.

SYMPTOMATOLOGY.

The Cause and Prevention of the Constitutional Symptoms following Deep Roentgentherapy.—S. Lange (*American Journal of Roentgenology*, July, 1916, p. 356).—The symptoms following deep X-ray therapy vary greatly with the general condition of the patient, with the nature and extent of his disease, and with the amount of X-ray dosage. The mildest type is an indefinite malaise felt for a day or two after the treatment. It may be so marked, however, as to completely prostrate the patient, necessitating rest in bed from one or two days to a week following each massive dose. This malaise is often accompanied by marked nervous and mental depression.

Nausea and loss of appetite is an almost constant accompaniment of the malaise, and may result in vomiting. The patient may vomit but once, usually two to six hours after the treatment, or the vomiting may persist for days. This frequently results in a loss of weight and strength, and may thus affect the prognosis.

While the malaise and nausea are the two most prominent symptoms, a variety of others may appear. There may be rapid swelling of the lymphatic glands in the irradiated areas, occurring two to six hours after the treatment.

The patient may also complain of a metallic taste in the mouth for some days after the treatment, and is unable to enjoy the flavour of his food, or there may be œdema and congestion of the mucous membranes in the areas under treatment, resulting in dryness of the mouth and throat, pain in swallowing, soreness of the intestines, etc.

The above symptoms occur only when massive doses are employed, and may never appear if the dosage is mild or moderate.

Smelling salts placed near the patient and electric fans were found to be only partially successful in preventing these untoward effects. It was, however, always possible to limit or prevent these after-effects by decreasing the dosage, especially by decreasing the voltage at the tube terminals.

The effect of the X-ray upon living cells is to break them down or to at least increase the katabolic changes in the cells. The products of the metabolic activity of living cells or of the disintegration of proteid material are largely acid in reaction. Lange consequently believes that these unpleasant constitutional symptoms following deep X-ray therapy are the result of an acidosis either local or general.

He now prescribes as a routine thirty grains of sodium bicarbonate three-hourly, to be continued forty-eight hours after each treatment. When the condition of the patient warrants, it is also given over twenty-four hours just previous to each treatment to increase the alkalinity of the blood and tissues. The patient is also encouraged to drink freely of alkaline waters, especially vichy. He also prescribes in each case an alkaline lotion (Dodd's formula) to be applied twice daily to the skin areas under treatment, as a prophylactic measure against the development of a reaction, and he feels that as a result of the persistent use of this lotion from the beginning of the treatment to the end that he has been able to increase the skin tolerance, and to deliver in this way a greater dose to the underlying tissues than would otherwise be possible.

If five grains of magnesium sulphate be added the dose of the alkali may be diminished.

R. W. A. S.

RADIOGRAPHY.

Relation of Dulness to Cardiac Outlines.—G. C. Shattuck (*Boston Medical and Surgical Journal*, March 2nd, 1916, p. 301).—This observer has made use of X rays as a means of checking the outlines of slight diminution of resonance as determined by light percussion.

The radiographic examinations were made with the patient standing six to seven feet from the tube, with the plate in front of him and the exposures made at mid-respiration.

Shattuck, as the result of his observations, has arrived at the following conclusions regarding ordinary percussion. It easily reveals gross abnormality in cardiac dulness to right or left. It may suggest slight abnormalities which must then be confirmed or disproved by other means. When percussion indicates slight cardiac enlargement, or no enlargement, palpation, auscultation, blood pressure, or history may provide further evidence of importance which can be used to check the results of percussion. When doubt still remains, teleoroentgenography, or the orthodiagraph, may be of service, but it should be remembered that variations of heart-size are dependent on many factors, and that the average man does not exist. Moreover, the errors of these methods in the hands of one who does not appreciate their difficulties, when applied to the heart, are large.

Percussion is especially unreliable for finding slight enlargement of the aortic arch, for determining the level of the apex, and for discovering hypertrophy of the left ventricle when there is little or no dilatation. It is not worth while to attempt by ordinary percussion methods to make a silhouette outline of the heart. It is better to note the relations of dulness in terms of interspaces and anatomical lines, and to compare the findings with a subjective standard based on experience, than to judge of enlargement by measurements of ordinary percussion outlines and comparison of them with orthodiagraphic standards. The attempt to make silhouette outlines of the heart by means of special methods of percussion has shown, in the hands of a few, results which are good but more or less uncertain.

R. W. A. S.

An Account of 80 Cases of Wounds of the Head seen in a Base Hospital in France.—J. F. Fairley and H. F. Woolfenden (*Medical Journal of Australia*, June 10th, 1916, p. 463).—The authors divide wounds of the cranium from bullets and fragments of shell into three varieties:—

(*a*) Perforating, *i.e.*, through and through.

(*b*) Penetrating.

(*c*) Tangential.

In the perforating type, the skull wound of entrance is just large enough to permit the entrance of a bullet, and is bevelled at the expense of the inner table. The exit wound is usually about 1 inch in diameter, and there is a greater tendency to splintering and comminution of the bone than in the wound of entrance.

In the penetrating type, the damage varies with the nature and velocity of the missile, from simple depressed fracture without perforation of the dura to enormous comminuted depressed fractures, with great laceration of the brain, the presence of splinters of bone, and the foreign body embedded in the brain substance when the foreign body had penetrated the dura. The missile is usually a piece of shell, which, fracturing the outer table and making greater inroads on the inner table, drives large pieces of bone deep into the brain substance, frequently opening the lateral ventricle.

In the tangential type, usually the result of a rifle bullet, the skull usually presents an elongated, oval, punched-out hole, bevelled greatly at the expense of the inner table. The remarkable fact is the great distance the fragments of depressed bone are driven into the brain.

Occasionally, both with penetrating and tangential injuries, large linear fractures, radiating from the point of impact of the missile, have been found. In these cases the skull was abnormally hard and compact and stoutly resisted the trephine at operation.

In estimating the amount of damage, the authors say that X rays are indispensable to the surgeon who wishes to have sufficient data to base rational operative procedures on. If the means of taking a radiograph are at hand, the probe should certainly not be used prior to radiography. If the skiagram be negative, then it may be permissible to employ a probe, if there be any reason to suspect a depressed fracture not disclosed by the plate.

In discussing the treatment, the writers advocate that an intact dura mater should not be incised but left intact. The type of case in which operation is most strongly indicated is the penetrating or tangential wound of the skull, where either a foreign body or fragments of skull are seen by X rays to be embedded in the brain, provided they are capable of removal, or when the skiagram reveals a definite depressed fracture which has probably lacerated the dura. These cases are almost invariably markedly septic, and call for operative procedure. It is very interesting to note that lumbar puncture is stated to have proved of value in permitting the removal of fragments and foreign bodies to be done more easily.

This article is based on careful observations on head injuries at one of the General Hospitals in France, and it is particularly sad that since preparing the article one of the authors, Captain Fairley, was taken suddenly ill and died. R. W. A. S.

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